

# **DISTRICT OF COLUMBIA**

## **DEPARTMENT OF TRANSPORTATION**



### **STANDARD SPECIFICATIONS FOR HIGHWAYS AND STRUCTURES**

**2009**

# **DISTRICT OF COLUMBIA**

## **DEPARTMENT OF TRANSPORTATION**



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**U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION**

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**101 DEFINITIONS AND TERMS****101.01 GENERAL**

Unless the intent is clearly otherwise apparent, words, clauses and phrases used in the Department's projects shall be construed according to rules of grammar and approved usage contained in Webster's Third New International Dictionary, Unabridged.

**101.02 ABBREVIATIONS**

Whenever the following abbreviations are used in these specifications or on the plans, the intent and meaning shall be interpreted as follows:

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ABS	Acrylonitrile-Butadiene-Styrene
AC	Asphalt Concrete
ACI	American Concrete Institute
AGC	Associated General Contractors of America, Inc.
AGMA	American Gear Manufacturers Association
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APA	American Plywood Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWS	American Welding Society
AWPA	American Wood Preservers Association
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standards
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration, U.S. Department of Transportation

FS	Federal Supply Standards
FSS	Federal Supply Standards, (General Services Administration)
IEEE	Institute of Electrical and Electronic Engineers, Inc.
MIL	Military Specifications
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NPS	National Park Service, U.S. Department of the Interior
NPT	National Pipe Thread
OSHA	Occupational Safety and Health Administration, U.S. Department of Labor
PCA	Portland Cement Association
PCC	Portland Cement Concrete
PTFE	Polytetrafluoroethylene
PVC	Polyvinylchloride
SAE	Society of Automotive Engineers
S.P.	Special Provision
SSPC	Steel Structures Painting Council
TAI	The Asphalt Institute
TCP	Traffic Control Plan
UL	Underwriter's Laboratories Incorporated
USS Gage	United States Standard Gage
W.S.P.	Working Steam Pressure

When reference is made to specifications of any organization listed above, or to any additional referenced specifications, the specifications shall be the current edition in effect on the date of advertising of the contract.

### 101.03 DEFINITIONS

Whenever the following terms are used, intent and meaning shall be interpreted as follows:

*Addendum* – Change in Contract Documents issued in writing prior to opening of bids.

*Advertisement* – A public announcement, as required by law, inviting bids for work to be performed, materials to be furnished, or proposals to be developed. Such advertisements will indicate with reasonable accuracy the quantity and location of the work to be done or the character and quantity of the material to be furnished and the time and place of the opening of proposals.

*Alley* – Public passageway for vehicles, pedestrians, drainage purposes, or any combination thereof, which connects with a street and which usually affords a means of access to the rear of properties abutting streets or highways.

*Award* – The decision of the Contracting Officer to accept the proposal of the lowest responsible bidder for the work, subject to the execution and approval of a satisfactory contract thereof and bond to secure the performance thereof, and to such other conditions as may be specified or required by law.

*Base Course* – The layer or layers of specified or selected material of designated thickness placed on a subbase or subgrade and used as a foundation to support a surface course.

*Bid Bond* – A guarantee by a surety company that the Contractor who submitted a bid on a project will not withdraw his bid for a specified period (usually 90 days) and that the surety company will in that time if notified to do so furnish a payment and performance bond that they will fulfill the terms of the contract.

*Bidder* – Any individual, firm, partnership, corporation or joint venture submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.

*Bridge* – A single or multiple span structure, including supports, erected over a depression or an obstacle such as water, highway or railway, and having a passageway for carrying traffic or other moving loads and having an opening measured along the center of the passageway of more than twenty feet.

*Bridge Length* – The greater dimension of a structure as measured along the center of the roadway between backs of abutment backwalls or between ends of bridge deck.

*Bridge Roadway Width* – The clear width of the superstructure measured at right angles to the center of the roadway between the bottom of curbs or, if curbs are not used, between the inner faces of parapet or railing.

*Calendar Day* – Each day shown on the calendar.

*Certified Minority Business Enterprise* – A business enterprise that has been issued a certification of registration by the District of Columbia, Minority Business Opportunity Commission qualifying it to perform certain categories of work.

*Change Order* – A written order issued by the Contracting Officer to the Contractor covering changes in the contract and establishing the basis of compensation and time adjustments for work affected by the changes.

*Chief Engineer* – Chief Transportation Engineer acting directly, or through and within authority of an authorized representative.

*Construction Completion Time* – The number of days, stated either in calendar days or as a completion date, allowed for completion of the contract, including authorized time extensions.

*Contract Documents* – Addenda, Contract Form, General Provisions, Labor Provision, Performance and Payment Bonds, Specifications, Special Provisions, Contract Drawings, approved written Change Orders, and Agreements required to acceptably complete the Contract including authorized extensions thereof.

*Contract Drawings* – All drawings, often referenced as Drawings or Plans (i.e., project drawings, Office Manual Drawings and other standard drawings) including reproductions of revisions thereof but exclusive of shop and working drawings and reference drawings, which show the location, character and dimensions of the prescribed work, including layouts, profiles, cross sections and other details.

*Contracting Officer* – The Director of the Department of Transportation or his/her representative authorized to enter into a contract on behalf of the District of Columbia.

*Contract Price* – The price stated in the Schedule of Prices.

*Contractor* – The individual, firm, partnership, corporation or joint venture under contract with the District for execution of prescribed work, acting directly or through a duly authorized representative.

*Culvert* – A structure other than a bridge which provides an opening under a roadway for drainage or other uses.

*Current* – As used in reference to specifications or methods of test, shall refer to those in effect at the time of advertisement for bids.

*Department* – The Department of Transportation, District of Columbia.

*Director* – The executive officer of the Department of Transportation.

*Earth* – The word “earth”, wherever used as the name of the excavated material or material to be excavated, shall mean all kinds of material other than rock as defined herein.

*Elevation* – The figures given on the Drawings or in the other Contract Documents after the word “elevation” or abbreviation of it shall mean the distance in feet above the standard datum used by the District.

*Embankment* – A raised structure of soil, soil aggregates, or rock below the subgrade.

*FHWA* – Federal Highway Administration of the United States Department of Transportation.

*Highway, Street or Road* – The entire right-of-way reserved for use in constructing or maintaining the roadway and its appurtenances.

*Holidays* – The following days are recognized as legal holidays:

New Year’s Day	Labor Day
Martin Luther King Jr. Birthday	Columbus Day
Presidents Day	Veterans Day

Memorial Day  
Independence Day

Thanksgiving Day  
Christmas Day

Any day declared a holiday by the District shall be observed. When a holiday falls on a Sunday, the following Monday will be observed as a Holiday. When a holiday falls on a Saturday, the preceding Friday will be observed.

*Inspector* – The Engineer’s authorized representative assigned to make any inspection of work performed and materials furnished.

*Invitation for Bids* – See Advertisement.

*Laboratory* – The established testing laboratory or other testing laboratories which may be designated by the Engineer for the performance of tests.

*Liquidated Damages* – The amount to be deducted from monies due the Contractor for failure to complete the work in the specified time.

*Notice to Proceed* – A written notice to the Contractor from the Contracting Officer stating the date on which the Contractor shall begin prosecution of work under contract, or to begin a phase of the work.

*Office Manual Drawings* – Detail Drawings of the Department of Transportation of general application.

*Pavement Structure* – The combination of base courses and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

*Pay Item (Bid Item, Item)* – An item of work specifically described and for which a price, either unit or lump sum, is provided.

*Pay Item Schedule (Schedule of Prices)* – A schedule showing the pay item number, the approximate quantity of each pay item, the price bid by the Contractor to be paid for each item of work performed under the contract, the total cost of each item, and the total amount bid by the Contractor.

*Performance and Payment Bond* – A guarantee by a surety company that the Contractor will be responsible for the performance and fulfillment of the contract and will pay all bills and accounts for materials and labor used in the work.

*Plans* – The contract drawings which show the location, character, and dimensions of the prescribed work, including layouts, profiles, cross sections and other details.

*Plant* – All physical resources, facilities, machinery, equipment, staging, forms, tools, work and storage space other than provided by the contract, together with subsidiary essentials and necessary maintenance for proper construction and acceptable completion of the project.

*Project* – The entire work to be completed under the contract.

*Proposal* – The offer of a bidder on the prescribed form, to perform stated construction work at the prices quoted.

*Proposal Form* – The prescribed form on which the offer of a bidder is to be submitted.

*Proposal Guaranty* – The security furnished with a bid to assure that the bidder will enter into the contract if his offer is accepted.

*Registered Professional Engineer* – Registered Professional Engineer in the fields of civil, structural, mechanical or electrical engineering, whose registration is acceptable to the District’s Board of Registration for Professional Engineers.

*Resident Engineer* – The authorized representative of the Engineer in charge of one or more construction contracts.

*Right-of-Way* – Land, property or interest therein acquired for or devoted to the District’s highway purposes.

*Roadbed* – Graded portions of highway upon which soils base, pavement or base, surface, shoulder, sidewalk, and median are constructed.

*Roadway* – The portion of the right-of-way intended for vehicular use.

*Rock* – Rock, wherever used as the name of an excavated material, shall mean only boulders and pieces of concrete or masonry exceeding one cubic yard in volume, and solid ledge rock which, in the Engineer’s opinion, requires for its removal, drilling and blasting, wedging, sledging, barring or breaking up with power-operated tools. No soft or disintegrated rock which can be removed with a hand pick or power operated excavator or shovel, or loose or previously blasted rock or broken stone in rock fillings or elsewhere, and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed as rock.

*Set Aside* – Designated projects procured in accordance with 49 CFR Part 23 for which bids from only qualified disadvantaged or women owned business enterprises may be considered for award.

*Sheltered Market* – Designated projects procured in accordance with the provisions of D.C. Law 1-95 (Minority Contracting Act of 1976) and on which only bids from minority business enterprises prequalified by the District of Columbia Minority Business Opportunity Commission will be accepted.

*Shop Drawings* – Drawings prepared by the fabricator or supplier showing the layout and details of components fabricated in a shop for inclusion in the permanent facility e.g., structural steel, reinforcing steel, railing, etc.

*Shoulder* – The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles for emergency use, and for lateral support of base and surface courses.

*Sidewalk* – The portion of the right-of-way intended for pedestrian use.

*Site* – The area upon or in which the Contractor’s operations are carried on and such other areas adjacent thereto as may be designated by the Engineer.

*Special Provisions (Designated as S.P.)* – Special directions and requirements peculiar to a project not otherwise thoroughly set forth in Standard Contract Provisions and Standard Specifications.

*Specifications* – All the directions, provisions and requirements contained in the Standard Specifications, Supplemental Specifications, and Special Provisions which are necessary for the proper performance of the contract.

*Specified Completion Date* – The date on which the contract work is specified to be completed.

*Standard Contract Provisions* – Standard Instructions to Bidders, General Provisions, Labor Provisions, Bid and Contract Forms as amended, for use with District of Columbia construction projects.

*Standard Specifications* – This book of provisions.

*Structures* – Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, end walls, buildings, sign supports, and appurtenant features encountered in the work and not otherwise classed herein.

*Subcontractor* – Any individual, partnership, firm, corporation or any acceptable combination thereof, or joint venture, to which the Contractor, with the consent of the Department, sublets part of the contract.

*Subgrade* – The top surface of a roadbed upon which the pavement structure and appurtenances are constructed.

*Substructure* – All of that part of a bridge below the bearings of simple or continuous spans, skewbacks of arches and tops of footings of rigid frames, including, backwalls.

*Superintendent* – The Contractor's authorized representative in responsible charge of the work.

*Supplemental Specifications* – Approved additions and revisions to the Standard Specifications.

*Surety* – The corporation, partnership or individual, other than the Contractor, executing a bond furnished by the Contractor.

*Surface Course* – The top layer of a pavement structure; Also referred to as wearing course or top course.

*Traffic Control Plan* – A formal plan prepared by the Department or by the Contractor indicating how traffic is to be managed through a construction project. The Traffic Control Plan (TCP) shall comply with the current edition of MUTCD.

*Tree Space* – The portion of the public right-of-way used or reserved for trees.

*Work* – The furnishing of all labor, materials, equipment, and incidentals necessary or convenient to the successful completion of the project and the carrying out of the duties and obligations imposed by the contract.

*Working Drawings* – Drawings furnished by the Contractor showing the layout and details of temporary construction, procedures and methods of construction, and data for construction equipment which are to be employed in the construction of the permanent facility (e.g., form drawings, erection drawings, load test pile procedures, pile hammer data).

In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that unless context clearly indicates another meaning, and supplementing intended written requirements, wherever anything is:

Acceptable	directed	ejected
accepted	disapproved	required
appropriate	equivalent	reserved
approved	given	significant
authorized	indicated	specified
comparable	insufficient	sufficient
contemplated	needed	suitable
designated	ordered	suspended
determined	permitted	unacceptable

or a comparable term is used, the words “as approved by the Engineer” or “to the Engineer” are applied as if they followed each term.

When drawings or plans are not a part of the contract, the words “per drawings” shall mean “as directed by the Engineer”.

**102 BIDDING REQUIREMENTS**  
**GOVERNMENT OF THE DISTRICT OF COLUMBIA**  
**STANDARD CONTRACT PROVISIONS**  
**FOR USE WITH SPECIFICATIONS FOR**  
**DISTRICT OF COLUMBIA GOVERNMENT**  
**CONSTRUCTION PROJECTS 1973, AS AMENDED**

**102.01 INSTRUCTIONS TO BIDDERS (Construction)**

**ARTICLE 1. QUALIFICATIONS OF BIDDERS** – Bidders shall have the capability to perform classes of work contemplated, have the necessary plant and sufficient capital to execute the work properly within specified time.

Any Bidder who has not performed comparable work for the District within the last 5 years shall submit, at the Contracting Officer's discretion, a certified statement of his organization, plant, manpower, financial resources, and construction experience that he considers will qualify him for proposed contract. This information shall be certified by a Certified Public Accountant for contracts over \$25,000. This requirement is not needed if the bidder has submitted such a statement to the District within a year prior to bid opening date, but will be required if bidder has previously submitted such a statement under one company name or organization or joint venture and is now bidding under another company name or organization or joint venture. A certified statement of prequalification approval by another jurisdiction may be considered as an alternative to foregoing procedure. A bidder shall submit a supplemental statement if requested by the District.

**ARTICLE 2. BID DOCUMENTS** – The Specifications (including all documents referenced therein and all documents attached thereto), drawings, and addenda which form the basis of any bid shall be considered as part thereof and will form part of the bid. Copies of these documents will be furnished to or made available for the inspection of prospective bidders by that office indicated in the advertisement or invitation.

**ARTICLE 3. EXAMINATION OF BID DOCUMENTS AND SITE OF WORK** – Each Bidder shall carefully examine the site of the proposed work and the bid documents and fully acquaint himself with conditions relating to construction and labor so that he may fully understand the facilities, difficulties, and restrictions attending the execution of the work under the bid documents, and he shall judge for and satisfy himself as to conditions to be encountered affecting the character, quality and quantity of the work to be performed and materials to be furnished and to the requirements of the bid documents. Failure to do so will be at the Bidder's own risk and shall not relieve him from any obligation under his bid or contract.

**ARTICLE 4. PREPARATION OF BIDS** – The bid form furnished in the bid proposal and specifications shall be used in strict compliance with the requirements of the Invitation and Supplemental Instructions to Bidders in the specifications. Special care shall be exercised in the preparation of bids. Bidders must make their own estimates of the facilities and difficulties to be anticipated upon execution of the contract, including local conditions, uncertainty of weather and all other contingencies. All designations and prices shall be fully and clearly set forth in the bid submission. ALL PRICES SHALL BE INSERTED IN FIGURES TYPED OR

PRINTED LEGIBLY ON THE BID FORM. All corrections on the bid documents must be initialed by the person signing the form.

**ARTICLE 5. ERROR IN BIDS** – Bidders or their authorized agents are expected to examine all bid documents and any addenda thereto, and all other instructions pertaining to the work which will be open to their inspection. Failure to do so will be at the bidder’s own risk, and will not constitute reason for relief on plea of error in the bid. **IN CASE OF ERROR IN THE EXTENSION OF PRICES IN THE BID, UNIT PRICES WILL GOVERN.**

The bidder must submit his plea of error in writing to the Contracting Officer and must be prepared to document and prove his error.

**ARTICLE 6. LABOR AND MATERIAL NOT FURNISHED BY DISTRICT** – The District will not furnish any labor, material, or supplies unless a provision to do so is included in the contract documents.

**ARTICLE 7. ADDENDA AND INTERPRETATIONS** – No oral interpretations of the meaning of the drawings, specifications, or other bid documents will be made to any bidder. Verbal clarification will not be binding on the District. All requests must be in writing and addressed to the Contracting Officer responsible for administering the contract. Requests for interpretations of bid documents must be received by the Contracting Officer not later than 10 days prior to bid opening date. All changes to the bid documents will be made by addenda mailed to all prospective bidders, who have obtained copies of the bid documents, not later than 7 days before bid opening date. In case of discrepancy among addenda, a later dated addendum has priority over earlier dated addenda. It shall be the bidder’s responsibility to make inquiry as to any or all addenda issued, and failure of any prospective bidder to receive any such addenda issued by the Contracting Officer shall not relieve the bidder from any obligation under his bid as submitted. Bidder must acknowledge receipt of all addenda on the Bid Form; failure to do so may result in rejection of bid. All addenda issued shall become part of the bid and contract documents.

**ARTICLE 8. ALTERNATE BIDS** – Alternate bids will not be considered unless called for in the Bid Form.

**ARTICLE 9. BIDS FOR ALL OR PART** – Where bids are not qualified by specific limitations, the District reserves the right to award all or any of the items according to its best interests.

**ARTICLE 10. PRICE SCHEDULE INTERPRETATION** – Quantities appearing in the Price Schedule are approximate only and are prepared for the comparison of bids. Payment will be made only for actual material requirements accepted and for work performed and accepted. Schedule quantities may be increased, decreased, or omitted and there shall be no adjustment in contract unit prices except as provided, and except for such materials actually purchased or work actually performed prior to notification of the change in items affected.

The price of any item, unless otherwise specified shall include full compensation for all materials, tests, samples, manufacturers’ guaranties, tools, equipment, labor, and incidental work needed to complete specified items. Prices without exception shall be net, not subject to discount, and shall include all royalties and costs arising from patents, proprietary items, trademarks, and copyrights.

**ARTICLE 11. CORRECTIONS** – Erasures and other changes in bids must be explained or noted over the signature of the bidder.

**ARTICLE 12. BOND REQUIREMENTS**

**A. BID GUARANTY** – On all bids of \$100,000 or more, security is required to insure the execution of the contract. No bid will be considered unless it is so guaranteed. Each bidder must furnish with his bid either a bid Bond (Form No. DC 2640-5), with good and sufficient sureties, a certified check payable to the order of the Treasurer of the District of Columbia (uncertified check will not be accepted), negotiable United States bonds (at par value), or an irrevocable letter of credit in an amount not less than five percent (5) of the amount of his bid as a guaranty that he will not withdraw said bid within the period specified therein after the opening of the same; or, if no period be specified, within ninety (90) days after said opening, and will, within the period specified therefore, or, if no period be specified, within ten (10) days, after the prescribed forms are forwarded to him for execution (or within any extension of time which may be granted by the officer to whom the bid was addressed) execute and deliver a written contract on the standard District form in accordance with the bid as accepted and give bond with good and sufficient sureties, as specified below for the faithful performance and proper fulfillment of such contract and payment of laborers and material men as required by law or, in the event of the withdrawal of said bid within the period above stated, of the failure to enter into such contract and give such bond within the time above stated, that he will pay to the District the difference between the amount specified in said bid and the amount for which the District may procure the required work, if the latter amount be in excess of the former.

Certified checks and United States bonds will be retained from the apparent first, second and third low bidders. All other bidders who have tendered monetary guarantees shall have deposits returned by Certified Mail. Certified checks and United States bonds will be returned to the second and third low bidders after award of contract and to successful bidders after the signing of prescribed forms of contract and bond. Guaranty bonds will be returned only upon written application.

**B. PERFORMANCE BOND** – For any construction contract exceeding \$100,000.00 in amount, a Performance Bond (Form No. DC 2640-7) shall be required in a penal amount equal to one hundred percent (100%) of the contract price at time of award.

Additional performance bond protection shall be required in connection with any modification effecting an increase in price under any contract for which a bond is required pursuant to the above if:

1. The modification is for new or additional work which is beyond the scope of the existing contract; or,
2. The modification is pursuant to an existing provision of the contract and is expected to increase the contract price by \$50,000 or twenty-five percent (25%) of the original total contract price, whichever is less.

The penal amount of the bond protection shall be increased so that the total performance bond protection is one hundred percent (100%) of the contract price as revised by both the modification requiring such additional protection and the aggregate of any previous modification. The increased penal amount may be secured either by increasing the bond

protection provided by existing surety or sureties or by obtaining an additional performance bond from a new surety.

**C. PAYMENT BOND** – In accordance with the provisions of Section 504(b) of the District of Columbia Procurement Practices Act of 1985, payment bonds shall be required in an amount not less than fifty percent (50%) of the total amount payable by the terms of the contract.

Additional payment protection shall be required in connection with any modification effecting an increase in price under any contract for which a bond is required pursuant to the above if:

1. The modification is for new or additional work which is beyond the scope of the existing contract; or
2. The modification is pursuant to an existing provision of the contract and is expected to increase the contract price by \$50,000 or twenty-five percent (25%) of the original total contract price, whichever is less.

The penal amount of the additional bond protection shall generally be such that the total payment bond protection is fifty percent (50%) of the contract price as revised by both the modification requiring such additional protection, and the aggregate of any previous modification. The additional protection may be secured either by increasing the bond protection provided by the existing surety or sureties or by obtaining an additional payment bond from a new surety.

**D. BOND SOURCE** – The bonds may be obtained from any surety company authorized by the U.S. Treasury Department as acceptable sureties on Federal Bonds and authorized to transact business in the District of Columbia by the Administrator, Insurance Administration, Department of Consumer and Regulatory Affairs.

**ARTICLE 13. SIGNATURE TO BIDS** – Each bid must show the full business address of the bidder and be signed by him with his usual signature. Bids by partnerships must be signed with the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and designation of the person signing. Bids by corporations must be signed with the name of the corporation, followed by the signature and designation of the President or Vice President and attested by the Secretary of the Corporation and the corporate seal affixed thereto. If bid is signed by other than the President or Vice President, evidence of authority to so sign must be furnished in the form of an extract of minutes of a meeting of the Board of Directors or extract of bylaws certified by the Corporate Secretary and corporate seal affixed thereto. The names of all persons signing shall be typed or printed below the signatures. A bid by a person who affixes to his signature the word “President”, “Vice President”, “Secretary”, “Agent”, or other designation, without disclosing his principal, may be held personally to the bid. Bids submitted by a joint venture must be signed by all authorized parties to the joint venture.

**ARTICLE 14. MARKING AND MAILING BIDS** – Bids (from Standard Contract Provisions), addenda acknowledgement, and bid guaranty must be securely sealed in suitable envelopes, addressed and marked on the outside with the name of the bidder, invitation number, and date of opening.

**ARTICLE 15. RECEIVING BIDS, MODIFICATIONS, OR WITHDRAWALS** – Bids received prior to the time set for opening will be securely kept unopened. The officer whose duty is to open them will decide when the specified time has arrived and no bid received thereafter will be considered unless: (1) they are sent by registered mail or by certified mail for which an official dated post office stamp (post-mark) on the original Receipt for Certified Mail has been obtained and it is determined by the District that the late receipt was due solely to delay in the mails for which the bidder was not responsible; or (2) if submitted by mail (or by telegram if authorized by the Contracting Officer), it is determined by the District that the late receipt was due solely to mishandling by the District after receipt at the District agency: Provided, that timely receipt at such agency is established upon examination of an appropriate date or time stamp or other documentary evidence or receipt within the control of such agency.

Bidders using certified mail are cautioned to obtain a receipt for certified mail showing legible, dated postmark and to retain such receipt against the chance that it will be required as evidence that a late bid was timely mailed. The only evidence acceptable in this matter is as follows: (1) where the Receipt of Certified Mail identifies the post office station of mailing, evidence furnished by the bidder which established that the business day of the station ended at an earlier time, in which case of the time of mailing shall be deemed to be last minute of the business day; or (2) an entry in ink on the Receipt for Certified Mail showing the time of mailing and the initials of postal employee receiving the item and making the entry, with appropriate written verification of such entry from the post office station of mailing, in which case the time of mailing shall be the time shown in the entry. If the postmark on the original Receipt for Certified Mail does not show a date, the bid shall not be considered.

The time of mailing of late bids submitted by registered or certified mail shall be deemed to be the last minute of the date shown in the postmark on the registered mail receipt or registered mail wrapper or on the Receipt for Certified Mail unless the bidder furnishes evidence from the post office station of mailing which establishes an earlier time.

No responsibility will attach to the District or any of its officers or employees for the premature opening of a bid not properly addressed and identified. Unless specifically authorized, telegraphic bids will not be considered, but modification by telegram, of bids already submitted will be considered if received prior to the hour set for opening, but should not reveal the amount of the original or revised bid.

**ARTICLE 16. WITHDRAWAL OF BIDS** – Bids may be withdrawn on written or telegraphic request received from bidders prior to the time fixed for opening, provided the name of the bidder appears on the outside of the envelope containing the bid. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

**ARTICLE 17. OPENING OF BIDS** – At the time fixed for the opening of bids, their contents will be made public by the Department of Transportation for the information of bidders and other properly interested persons.

**ARTICLE 18. AWARD OR REJECTION** – The Contract will be awarded to the lowest responsible bidder complying with conditions of the bid documents, provided his bid is reasonable and it is in the best interest of the District to accept it. The bidder to whom award is made will be notified by the Contracting Officer at the earliest possible date. The District,

however, reserves the right to reject any and all bids and to waive any informality in bids received whenever such rejection or waiver is in the best interest of the District.

If more than one bid be offered by any one party, by or in the name of his or their clerk, partner, or other person, all such bids may be rejected. This shall not prevent a bidder from proceeding under Article 8 hereof, nor from quoting different prices on different qualities of materials or different conditions of delivery. A supplier or material man who has quoted prices on materials to a bidder is not thereby disqualified from quoting to other bidders or from submitting a bid directly for the materials or work.

Each bidder shall bid on all items in the Pay Item Schedule and in accordance with the instructions below. Failure to bid on all items will give the District the option to reject the bid.

The Contracting Officer reserves the right to waive any informalities, to reject any or all bids, or to readvertise for bids. Awards, if made, will be to the lowest responsible and qualified bidders whose bids are responsive to the invitation and is most advantageous to the District of Columbia, price and other factors considered.

In addition to requirements for qualification of bidders as set forth in Article 1 hereof, and as determined by the District, proposals will be considered irregular and may be rejected by the Contracting Officer for any of, but not limited to, the following reasons:

- A. Incompetency, inadequate plant, or insufficient capital as revealed by bidder's statement on AGC or equivalent form.
- B. Evidence of collusion.
- C. Uncompleted work which might hinder or prevent proper and prompt execution and completion of work contemplated.
- D. Evidence that bidder has not adequately considered all aspects of contemplated work.
- E. Failure to settle bills satisfactorily, claims and judgments due for labor and material on bidder's contracts in force on bid opening date.
- F. Default under previous contracts.
- G. Unacceptable rating as listed on published government lists.
- H. Proposal submission on form other than that form furnished by District, or altered or partially detached form.
- I. Unauthorized additions, deletions, omissions, conditional bids, or irregularities which may make proposal incomplete or ambiguous in meaning.
- J. Failure to acknowledge all addenda issued.
- K. Failure to submit bid in the properly labeled receptacle in the Bid Room (2nd floor) of the Department of Transportation, 2000 14th Street, N.W., Washington, D.C. 20009, and prior to the time set for opening as governed by the Official Clock designated as such in that Branch; or if bid is mailed, it is received at P.O. Box 43182-9182 by the designated time.

**ARTICLE 19. CANCELLATION OF AWARDS** – The right is reserved to the District, without any liability upon the District, to cancel the award of any contract at any time prior to approval of a formal written contract signed by the Contractor and the Contracting Officer.

**102.02 PROPOSAL FORMS**

The District will furnish each bidder a proposal form which will state the estimated quantity for each and every item upon which a bid is required, a description of the work to be done, the time in which the work must be completed, and the date, place, and time proposals will be opened. It will also state any Special Provision, Supplemental Specifications or requirements which vary from, or are not contained in, the Standard Specifications.

**102.03 RESERVED****102.04 AFFIRMATIVE ACTION PROGRAM**

Submission by the Contractor and all subcontractors of an Affirmative Action Plan in compliance with Mayor's Order 85-85 is required. This Affirmative Action Plan must be received by the Contracting Officer, within five (5) working days subsequent to the bid opening. Failure to comply in a timely manner may render a bid non-responsive. Contract award is conditioned on the approval of the Affirmative Action Program. The goals for minority and female participation are as follows:

- (1) The goal for minority participation expressed in percentage terms for the Contractor's workforce in each trade on all construction work in the covered area is forty-two percent (42%) or such other percentage specified in the Specifications and Bid Forms by the Contracting Officer.
- (2) The goal of 6.9%, or such other percentage specified in the Specifications and Bid Forms by the Contracting Officer, for female participation is applicable to the Contractor's aggregate on-site construction workforce. This goal is applicable whether or not part of that workforce is performing work on a Federal or federally-assisted construction contract or subcontract.

These goals are applicable to all of the Contractor's work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, he or she shall apply to goals established for such geographical area where the work is subject to the goals for both its federally involved and non-federally involved construction.

Each bidder should submit a certificate with the bids, signed by an official of the company that he or she is aware of the aforementioned orders and that he or she will comply with them in the performance of the contract.

**102.05 NON COLLUSION**

Every bid submitted shall contain an affidavit signed by an official of the company submitting the bid that said company has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the proposed contract.

**102.06 ANTI-DISCRIMINATION CLAUSE**

The Contractor: (1) shall not discriminate in any manner against any employee or applicant for employment in violation of Section 211 of the District of Columbia Human Rights Act

(D.C. Law 2-38; D.C. Code Anno. Section 1-2512); (2) shall include a similar clause in every subcontract, except subcontracts for standard commercial supplies or raw materials; and (3) shall, along with all subcontractors, post in a conspicuous place, available to employees and applicants for employment, a notice setting forth the provisions of the non-discrimination clause set out in Section 251 of the District of Columbia Human Rights Act (D.C. Code Anno. Section 1-2522).

#### **102.07 EQUAL EMPLOYMENT OPPORTUNITY CERTIFICATION**

When required in the Special Provisions the bidder shall submit a certification with his or her bid that he or she has or has not participated in a contract or subcontract subject to in substance either the equal opportunity provisions of 103.02(E) or Section 202 of Executive Order 11246 of 3 CFR; that he or she has or has not filed all required compliance reports under any such contract or subcontract; and that representation indicating submission of required compliance reports signed by proposed subcontractors will be obtained prior to subcontract awards.

#### **102.08 NONSEGREGATED FACILITIES CERTIFICATION**

When required in the Special Provisions the bidder shall submit a certification with his or her bid that he or she does not and will not maintain or provide for his or her employees any segregated facility at any of his or her establishments; that he or she does not and will not permit his or her employees to perform their services at any location under his or her control where segregated facilities are maintained; and that he or she will obtain and retain identical certifications from proposed subcontractors prior to award of subcontracts exceeding \$10,000.00.

“Segregated facilities” shall mean any waiting room, work area, wash and rest room, eating area, time clock, locker room and other storage or dressing area, parking lot, drinking fountain, recreation or entertainment area, transportation and housing facility, provided for employees which is segregated by explicit directive or is segregated on the basis of race, creed, color, or national origin, because of habit, local custom or otherwise.

Penalty for violations or making false statements is prescribed in 18 USC 1001.

#### **102.09 RESERVED**

#### **102.10 EMPLOYMENT OF THE HANDICAPPED**

Pursuant to the Rehabilitation Act of 1973 (for Federal and federally-assisted projects), DC Human Rights Act of 1977 for District of Columbia-funded projects, and the Americans With Disabilities Act, the Contractor and all subcontractors agree not to discriminate against any handicapped person who is qualified to perform the job. The Contractor also agrees to take Affirmative Action to hire, advance, and treat handicapped people without discrimination.

**103 STANDARD CONTRACT PROVISIONS****103.01 GENERAL PROVISIONS (CONSTRUCTION CONTRACT)****ARTICLE 1. DEFINITIONS**

- A. "District" as used herein means the District of Columbia, a municipal corporation.
- B. "Mayor" as used herein means the elected head of the District as set forth in Public Law 93-198, dated December 24, 1973, Title 4, Part B, Section 422(1).
- C. "Contracting Officer" as used herein means the head of the Department authorized to execute and administrate the Contract on behalf of the District and shall include his duly appointed successor and his authorized representative.
- D. "Contract Documents" or "Contract" as used herein means Addenda, Contract Form, Instructions to Bidders, General Provisions, Labor Provisions, Performance and Payment Bonds, Specifications, Special Provisions, Contract Drawings, approved written Change Orders and Agreements required to acceptably complete the Contract, including authorized extensions thereof.

**ARTICLE 2. ORDER OF PRECEDENCE**

The Contractor shall keep on the work site a copy of Contract drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the contract drawings, or shown on the Contract drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both.

All contract requirements are equally binding. Each Contract requirement, whether or not omitted elsewhere in the Contract, is binding as though occurring in any or all parts of the Contract. In case of discrepancy:

- 1. The Contracting Officer shall be promptly notified in writing of any error, discrepancy, or omission, apparent or otherwise.
- 2. Applicable Federal and D.C. Code requirements have priority over: the Contract form, General Provisions, Change Orders, Addenda, Contract drawings, Special Provisions and Specifications.
- 3. The Contract form, General Provisions and Labor Provisions have priority over: Change Orders, Addenda, Contract drawings, Special Provisions and Specifications.
- 4. Change Orders have priority over: Addenda, Contract drawings and Specifications.
- 5. Addenda have priority over: Contract drawings, Special Provisions and Specifications. A later dated Addendum has priority over earlier dated Addenda.
- 6. Special Provisions have priority over: Contract drawings and other specifications.
- 7. Shown and indicated dimensions have priority over scaled dimensions.
- 8. Original scale drawings and details have priority over any other different scale drawings and details.
- 9. Large scale drawings and details have priority over small scale drawings and details.

Any adjustment by the Contractor without a prior determination by the Contracting Officer shall be at his own risk and expense. The Contracting Officer will furnish from time to time

such detail drawings and other information as he may consider necessary, unless otherwise provided.

### ARTICLE 3. CHANGES

**A. DESIGNATED CHANGE ORDERS** – The Contracting Officer may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make any change in the work within the general scope of the Contract, including but not limited to changes:

1. In the Contract drawings and specifications;
2. In the method or manner of performance of the work;
3. In the District furnished facilities, equipment, materials, or services; or;
4. Directing acceleration in the performance of the work.

Nothing provided in this Article shall excuse the Contractor from proceeding with the prosecution of the work so changed.

**B. OTHER CHANGE ORDERS** – Any other written order or an oral order (which term as used in this Section (B) shall include direction, instruction, interpretation, or determination) from the Contracting Officer, which causes any such change, shall be treated as a Change Order under this Article, provided that the Contractor gives the Contracting Officer written notice stating the date, circumstances and sources of the order and that the Contractor regards the order as a Change Order.

**C. GENERAL REQUIREMENTS** – Except as herein provided, no order, statement or conduct of the Contracting Officer shall be treated as a change under this Article or entitle the Contractor to an equitable adjustment hereunder.

If any change under this Article causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of this work under the Contract, whether or not changed by any order, an equitable adjustment shall be made and the Contract modified in writing accordingly. Provided, however, that except for claims based on defective specifications, no claim for any change under (B) above shall be allowed for any cost incurred more than 20 days before the Contractor gives written notice as therein required unless this 20 days is extended by the Contracting Officer. And provided further, that in case of defective drawings and specifications, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with such defective drawings and specifications.

If the Contractor intends to assert a claim for an equitable adjustment under this Article, he must within 30 days after receipt of a written Change Order under (A) above or the furnishing of a written notice under (B) above, submit to the Contracting Officer a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by the Contracting Officer. The statement of claim hereunder may be included in the notice under (B) above.

No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under the Contract.

**D. CHANGE ORDER BREAKDOWN** – Contract prices shall be used for Change Order work where work is of similar nature; no other costs, overhead, or profit will be allowed.

Where Contract prices are not appropriate and the nature of the change is known in advance of construction, the parties shall attempt to agree on a fully justifiable price adjustment and/or adjustment of completion time.

When Contract prices are not appropriate, or the parties fail to agree on equitable adjustment, or in processing claims, equitable adjustment for Change Order work shall be per this Article and Article 4 and shall be based upon the breakdown shown in following subsections 1. through 7. The Contractor shall assemble a complete cost breakdown that lists and substantiates each item of work and each item of cost.

- 1. Labor** – Payment will be made for direct labor cost plus indirect labor cost such as insurance, taxes, fringe benefits and welfare provided such costs are considered reasonable. Indirect costs shall be itemized and verified by receipted invoices. If verification is not possible, up to 18 percent of direct labor costs may be allowed. In addition, up to 20 percent of direct plus indirect labor costs may be allowed for overhead and profit.
- 2. Bond** – Payment for additional bond cost will be made per bond rate schedule submitted to the Department of Transportation with the executed Contract.
- 3. Materials** – Payment for cost of required materials will be F.O.B. destination (job site) with an allowance up to 15% for overhead and profit.
- 4. Rented Equipment** – Payment for required equipment rented from an outside company that is neither an affiliate of, nor a subsidiary of, the Contractor will be based on receipted invoices which shall not exceed rates given in the current edition of the Rental Rate Blue Book for Construction Equipment published by Data Quest. If actual rental rates exceed manual rates, written justification shall be furnished to the Contracting Officer for consideration. No additional allowance will be made for overhead and profit. The Contractor shall submit written certification to the Contracting Officer that any required rented equipment is neither owned by nor rented from the Contractor or an affiliate of or subsidiary of the Contractor.
- 5. Contractor's Equipment** – Payment for required equipment owned by the Contractor or an affiliate of the Contractor will be based solely on an hourly rate derived by dividing the current appropriate monthly rate by 176 hours. No payment will be made under any circumstances for repair costs, freight and transportation charges, fuel, lubricants, insurance, any other costs and expenses or overhead and profit. Payment for such equipment made idle by delays attributable to the District will be based on one-half the derived hourly rate under this subsection.
- 6. Miscellaneous** – No additional allowance will be made for general superintendence, use of small tools, and other costs for which no specific allowance is herein provided.
- 7. Subcontract Work** – Payment for additional necessary subcontract work will be based on applicable procedures in 1. through 6., to which total additional subcontract work up to an additional 10 percent may be allowed for the Contractor's overhead and profit.

**ARTICLE 4. EQUITABLE ADJUSTMENT OF CONTRACT TERMS**

Pursuant to 23 CFR 635.109, the Contractor is entitled to an equitable adjustment of the contract terms whenever the following situations develop:

*Differing Site Conditions:*

- (1) During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site, the Contractor, upon discovering such conditions, shall promptly notify the Contracting Officer in writing of the specific differing conditions before they are disturbed and before the affected work is performed.
- (2) Upon written notification, the Contracting Officer will investigate the conditions, and if he/she determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding loss of anticipated profits, will be made and the contract modified in writing accordingly. The Chief Engineer will notify the Contractor of his/her determination whether or not an adjustment of the contract is warranted.
- (3) No contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.
- (4) No contract adjustment will be allowed under this clause for any effects caused on unchanged work.

*Suspensions of Work Ordered by the Contracting Officer:*

- (1) If the performance of all or any portion of the work is suspended or delayed by the Contracting Officer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the Contractor shall submit to the Contracting Officer in writing a request for adjustment within seven (7) calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.
- (2) Upon receipt, the Contracting Officer will evaluate the Contractor's request. If the Contracting Officer agrees that the cost and/or time required for the performance of the contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Contracting Officer will make an adjustment (excluding profit) and modify the contract in writing accordingly. The Contracting Officer will notify the Contractor of his/her determination whether or not an adjustment of the contract is warranted.
- (3) No contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.

- (4) No contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this contract.

*Significant Changes in the Character of Work*

- (1) The Contracting Officer reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the contract nor release the surety, and the Contractor agrees to perform the work as altered.
- (2) If the alterations or changes in quantities significantly change the character of the work under the contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the contract. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Contracting Officer may determine to be fair and equitable.
- (3) If the alterations or changes in quantities significantly change the character of the work to be performed under the contract, the altered work will be paid for as provided elsewhere in the contract.
- (4) The term "significant change" shall be construed to apply only to the following circumstances:
  - (a) When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction or
  - (b) When an item of work is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

**ARTICLE 5. TERMINATION-DELAYS**

If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within the time specified in the Contract, or any extension thereof, or fails to complete said work within specified time, the District may, by written notice to the Contractor, terminate his right to proceed with the work or such part of the work involving the delay. In such event the District may take over the work and prosecute the same to completion, by contract or otherwise, and may take possession of and utilize in completing the work such materials, appliances, and plant as may have been paid for by the District or may be on the site of the work and necessary thereof. Whether or not the Contractor's right to proceed with the work is terminated, he and his sureties shall be liable for any liability to the District resulting from his refusal or failure to complete the work within the specified time.

If fixed and agreed liquidated damages are provided in the Contract and if the District does not so terminate the Contractor's right to proceed, the resulting damage will consist of such liquidated damages until the work is completed or accepted.

The Contractor's right to proceed shall not be so terminated nor the Contractor charged with resulting damage if:

1. The delay in the completion of the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to acts of God, acts of the public enemy, acts of the District in either its sovereign or contractual capacity, acts of another contractor in the performance of a contract with the District, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, climatic conditions beyond the normal which could be anticipated, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and such subcontractors or suppliers (the term subcontractors or suppliers shall mean subcontractors or suppliers at any tier); and
2. The Contractor, within ten (10) days from the beginning of any such delay, (unless the Contracting Officer grants a further period of time before the date of final payment under the Contract) notifies the Contracting Officer in writing of the causes of delay.

The Contracting Officer shall ascertain the facts and the extent of the delay and extend the time for completing the work when, in his judgement, the findings of fact justify such an extension, and his findings of fact shall be final and conclusive on the parties, subject only to appeal as provided in Article 7 herein.

If after notice of termination of the Contractor's right to proceed under the provisions of this article, it is determined for any reason that the Contractor was not in fault under the provisions of this Article, or that the delay was excusable under the provisions of this Article, the rights and obligations of the parties shall be in accordance with Article 6 herein. Failure to agree to any such adjustment shall be a dispute concerning a question of fact within the meaning of Article 7 herein.

The rights and remedies of the District provided in this Article are in addition to any other rights and remedies provided by law or under the Contract.

The District may, by written notice, terminate the Contract or a portion thereof as a result of an Executive Order of the President of the United States with respect to the prosecution of war or in the interest of national defense. When the Contract is so terminated, no claim for loss of anticipated profits will be permitted.

#### **ARTICLE 6. TERMINATION FOR CONVENIENCE OF THE DISTRICT**

- A. The performance of work under the Contract may be terminated by the District in accordance with this Article in whole, or in part, whenever the Contracting Officer shall determine that such termination is in the best interest of the District. Any such termination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which performance of work under the Contract is terminated, and the date upon which such termination becomes effective.

- B.** After receipt of a Notice of Termination, and except as otherwise directed by the Contracting Officer, the Contractor shall:
- 1.** Stop work under the Contract on the date and to the extent specified in the Notice of Termination.
  - 2.** Place no further orders or subcontracts for materials, services, or facilities except as may be necessary for completion of such portion of the work under the Contract as is not terminated.
  - 3.** Terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the Notice of Termination.
  - 4.** Assign to the District, in the manner, at the times, and to the extent directed by the Contracting Officer, all of the right, title, and interest of the Contractor under the order and subcontracts so terminated, in which case the District shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts.
  - 5.** Settle all outstanding liabilities and all claims arising out of such termination of orders or subcontracts, with the approval or ratification of the Contracting Officer to the extent he may require, which approval or ratification shall be final for all purposes of this Article.
  - 6.** Transfer title to the District and deliver in the manner, at the times, and to the extent, if any, directed by the Contracting Officer:
    - a.** The fabricated or unfabricated parts, work in progress, completed work, supplies, and other materials procured as a part of, or acquired in connection with, the performance of the work terminated by the Notice of Termination; and
    - b.** The completed or partially completed plans, drawings, information, and other property which, if the Contract had been completed, would have been required to be furnished to the District.
  - 7.** Use his best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by the Contracting Officer, any property of the types referred to in 6 above provided, however, that the Contractor:
    - a.** Shall not be required to extend credit to any purchase, and
    - b.** May acquire any property under the conditions prescribed and at a price or prices approved by the Contracting Officer, and
    - c.** Provided further, that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the District to the Contractor under the Contract or shall otherwise be credited to the price or cost of the work covered by the Contract or paid in such other manner as the Contracting Officer may direct.
  - 8.** Complete performance of such part of the work as shall not have been terminated by the Notice of Termination.

9. Take such action as may be necessary, or as the Contracting Officer may direct, for the protection and preservation of the property related to the Contract which is in the possession of the Contractor and in which the District has or may acquire an interest.
10. The Contractor shall proceed immediately with the performance of the above obligations notwithstanding any delay in determining or adjusting the cost, or any item of reimbursable cost, under this Article.
11. "Plant clearance period" means, for each particular property classification (such as raw materials, purchased parts, and work in progress) at any one plant or location, a period beginning with the effective date of the termination for convenience and ending 90 days after receipt by the Contracting Officer of acceptable inventory schedules covering all items at that particular property classification in the termination inventory at that plant or location, or ending on such later date as may be agreed to by the Contracting Officer and the Contractor. Final phase of plant clearance period means that part of a plant clearance period which occurs after the receipt of acceptable inventory schedules covering all items of the particular property classification at the plant or location.

At any time after expiration of the plant clearance period, as defined above, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of any or all items of termination inventory not previously disposed of, exclusive of items the disposition of which has been directed or authorized by the Contracting Officer, and may request the District to remove such items or enter into a storage agreement covering them. Not later than 15 days thereafter, the District will accept title to such items, and remove them or enter into a storage agreement covering the same; provided, that the list submitted shall be subject to verification by the Contracting Officer upon removal of the items or, if the items are stored, within 45 days from the date of submission of the list, and any necessary adjustments to correct the list as submitted, shall be made prior to final settlement.

- C. After receipt of a Notice of Termination, the Contractor shall submit to the Contracting Officer his termination claim, in the form with the certification prescribed by the Contracting Officer. Such claim shall be submitted promptly but in no event later than one year from the effective date of termination, unless one or more extensions in writing are granted by the Contracting Officer upon request of the Contractor made in writing within such one year period or authorized extension thereof. However, if the Contracting Officer determines that the facts justify such action, he may receive and act upon any such termination claim at any time after such one year period or extension thereof. Upon failure of the Contractor to submit his termination claim within the time allowed, the Contracting Officer may, subject to any review required by the District's procedures in effect as of the date of execution of the Contract, determine on the basis of information available to him, the amount, if any, due to the Contractor by reason of termination and shall thereupon pay to the Contractor the amount so determined.
- D. Subject to the provisions of C. above, the subject to any review required by the District's procedures in effect as of the date of execution of the Contract, the Contractor and Contracting Officer may agree upon the whole or any part of the amount or amounts to be paid to the Contractor by reason of the total or partial termination of work pursuant to this Article, which amount or amounts may include a reasonable allowance for profit on work done; provided, that such agreed amount or amounts, exclusive of settlement costs, shall

not exceed that total contract price as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work not terminated. The Contract shall be amended accordingly, and the Contractor shall be paid the agreed amount. Nothing in E. below prescribing the amount to be paid to the Contractor in the event of failure of the Contractor and the Contracting Officer to agree upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this Article, shall be deemed to limit, restrict, or otherwise determine or effect the amount or amounts which may be agreed upon to be paid to the Contractor pursuant to this paragraph.

- E.** In the event of the failure of the Contractor and the Contracting Officer to agree as provided in D. above upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this Article, the Contracting Officer shall, subject to any review required by the District's procedures in effect as of the date of execution of the Contract, determine, on the basis of information available to him, the amount, if any, due the Contractor by reason of the termination and shall pay to the Contractor the amounts determined by the Contracting Officer, as follows, but without duplication of any amounts agreed upon in accordance with D. above:
- 1.** With respect to all Contract work performed prior to the effective date of the Notice of Termination, the total (without duplication of any items) of:
    - a.** The cost of such work;
    - b.** The cost of settling and paying claims arising out of the termination of work under subcontracts or orders as provided in B. 5. above, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by the subcontractor prior to the effective date of the Notice of Termination of work under the Contract, which amounts shall be included in the cost on account of which payment is made under E. 1. a. above; and
    - c.** A sum, as profit on E. 1. a. above, determined by the Contracting Officer to be fair and reasonable; provided however, that if it appears that the Contractor would have sustained a loss on the entire Contract had it been completed, no profit shall be included or allowed under this subparagraph and an appropriate adjustment shall be made reducing the amount of the settlement to reflect the indicated rate of loss; and provided further that profit shall be allowed only on preparation made and work done by the Contractor for the terminated portion of the Contract but may not be allowed on the Contractor's settlement expenses. Anticipatory profits and consequential damages will not be allowed. Any reasonable method may be used to arrive at a fair profit, separately or as part of the whole statement.
  - 2.** The reasonable cost of the preservation as protection of property incurred pursuant to B. 9; and any other reasonable cost incidental to the termination of work under the Contract including expense incidental to the determination of the amount due to the Contractor as the result of the termination of work under the Contract.
- F.** The total sum to be paid to the Contractor under E. 1. above shall not exceed the total Contract price as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work not terminated. Except for normal spoilage, and except to the extent that the District shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor under E. 1.

above, the fair value, as determined by the Contracting Officer, of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to the District, or to a buyer pursuant to B.7. above.

- G.** The Contractor shall have the right of appeal under Article 7. herein, from any determination made by the Contracting Officer under C. or E. above, except that, if the Contractor has failed to submit his claim within the time provided in C. above and has failed to request extension of such time, he shall have no such right of appeal. In any case where the Contracting Officer has made a determination of the amount due under C. and E above, the District shall pay to the Contractor the following:
1. If there is no right of appeal hereunder or if no timely appeal has been taken, the amount so determined by the Contracting Officer, or
  2. If an appeal has been taken, the amount finally determined on such appeal.
- H.** In arriving at the amount due the Contractor under this Article, there shall be deducted:
1. all unliquidated advance or other payments on account theretofore made to the Contractor, applicable to the terminated portion of the Contract;
  2. any claim which the District may have against the Contractor in connection with the Contract; and
  3. the agreed price for, or the proceeds of sale of, any materials, supplies, or other things kept by the Contractor or sold, pursuant to the provisions of this Article and not otherwise recovered by or credited to the District.
- I.** If the termination hereunder be partial, prior to the settlement of the terminated portion of the Contract, the Contractor may file with the Contracting Officer a request in writing for an equitable adjustment of the price or prices specified in the Contract relating to the continued portion of the Contract (the portion not terminated by the Notice of Termination), and such equitable adjustment as may be agreed upon shall be made at such price or prices; however, nothing contained herein shall limit the right of the District and the Contractor to agree upon the amount or amounts to be paid to the Contractor for the completion of the continued portion of the Contract when said Contract does not contain an established Contract price for such continued portion.
- J.** The District may from time to time, under such terms and conditions as it may prescribe, make partial payments against costs incurred by the Contractor in connection with the terminated portion of the Contract whenever in the opinion of the Contracting Officer the aggregate of such payments shall be within the amount to which the Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this Article, such excess shall be payable by the Contractor to the District upon demand, together with interest computed at the rate of 6 percent per annum for the period from the date such excess is received by the Contractor to the date on which such excess is repaid to the District; provided however, that no interest shall be charged with respect to any such excess payment attributable to a reduction in the Contractor's claim by reason of retention or other disposition of termination inventory until ten days after the date of such retention or disposition, or such later date as determined by the Contracting Officer by reason of the circumstances.

- K.** Unless otherwise provided in the Contract or by applicable statute, the Contractor, from the effective date of termination and for a period of three years after final settlement under the Contract, shall preserve and make available to the District at all reasonable times at the office of the Contractor, but without direct charge to the District, all his books, records, documents, and other evidence bearing on the costs and expenses of the Contractor under the Contract and relating to the work terminated hereunder, or, to the extent approved by the Contracting Officer, photographs and other authentic reproductions thereof.

## **ARTICLE 7. DISPUTES**

All disputes arising under or relating to a contract shall be resolved as provided herein.

### **A. Claims by a Contractor against the District**

Claim, as used in this clause, means a written assertion by the Contractor seeking as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to a contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant.

- (a) All claims by a Contractor against the District arising under or relating to a contract shall be in writing and shall be submitted to the Contracting Officer for a decision. The Contractor's claim shall include at least the following:
- (1) A description of the claim and the amount in dispute.
  - (2) Any data or other information to support the claim.
  - (3) A brief description of the Contractor's efforts to resolve the dispute prior to filing the claim, and
  - (4) The Contractor's request for relief or other action by the Contracting Officer.
  - (5) Certification that, to the best of the Contractor's knowledge, the cost and pricing data included with the claim is accurate, complete and current as of the date of claim submission. The Contractor shall agree that there is a continuing requirement to update cost and pricing data through the date of negotiations with the District are completed. The Contractor shall also agree that prices, including profit or fee, will be adjusted to exclude any significant price increases occurring as a result of cost or pricing data that was inaccurate, incomplete or not current.
- (b) The Contracting Officer may meet with the Contractor in a further attempt to resolve the claim by agreement.
- (c) For any claim of \$50,000.00 or less, the Contracting Officer shall issue a decision within sixty (60) calendar days from receipt of a written request from a Contractor that a decision be rendered within that period.
- (d) For any claim over \$50,000.00, the Contracting Officer shall issue a decision within ninety (90) calendar days of receipt of the claim. Whenever possible, the Contracting Officer shall take into account such factors as the size and

complexity of the claim and the adequacy of the information in support of the claim provided by the Contractor.

- (e) The Contracting Officer's written decision shall include the following:
  - (1) Provide a description of the claim or dispute.
  - (2) Refer to pertinent contract terms.
  - (3) State the factual areas of agreement and disagreement.
  - (4) State the reasons for the decision, including any specific findings of fact, although specific findings of fact are not required and, shall not be binding in any subsequent proceeding.
  - (5) If all or any part of the claim is determined to be valid, determine the amount of monetary settlement, the contract adjustment to be made, or other relief to be granted.
  - (6) Indicate that the written document is the Contracting Officer's final decision, and,
  - (7) Inform the Contractor of the right to seek further redress by appealing the decision to the Contract Appeals Board.
- (f) Any failure by the Contracting Officer to issue a decision on a contract claim within the required time period will be deemed to be a denial of the claim, and will authorize the commencement of an appeal to the Contract Appeals Board, as authorized by D.C. Official Code § 2-309.04.
- (g)
  - (1) If the Contractor is unable to support any part of his or her claim and it is determined that the inability is attributable to a material misrepresentation of fact or fraud on the part of the Contractor, the Contractor shall be liable to the District for an amount equal to the unsupported part of the claim in addition to all costs to the District attributable to the cost of reviewing that part of the Contractor's claim.
  - (2) Liability under paragraph g.1. shall be determined within six (6) years of the commission of the misrepresentation of fact or fraud.
- (h) The decision of the Contracting Officer shall be final and not subject to review unless an administrative appeal or action for judicial review is timely commenced by the Contractor as authorized by D.C. Official Code § 2-309.04.
- (i) Pending final decision of an appeal, action, or final settlement, a Contractor shall proceed diligently with performance of the contract in accordance with the decision of the Contracting Officer.

#### **Claims by the District against a Contractor**

- (a) Claim as used in this clause means a written demand or written assertion by the District seeking, as a matter of right, the payment of money in a sum certain, the adjustment of contract terms, or other relief arising under or relating to a contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides relief sought by the claimant.

- (b) (1) All claims by the District against a Contractor arising under or relating to a contract shall be decided by the Contracting Officer.
- (2) The Contracting Officer shall send written notice of the claim to the Contractor. The Contracting Officer's written decision shall do the following:
  - (a) Provide a description of the claim or dispute;
  - (b) Refer to pertinent contract terms;
  - (c) State the factual areas of agreement and disagreement;
  - (d) State the reasons for the decision, including any specific findings of fact, although specific findings of fact are not required and, if made, shall not be binding in any subsequent proceeding;
  - (e) If all or any part of the claim is determined to be valid, determine the amount of monetary settlement, the contract adjustment to be made, or other relief to be granted.
  - (f) Indicate that the written document is the Contracting Officer's final decision, and
  - (g) Inform the Contractor of the right to seek further redress by appealing the decision to the Contract Appeals Board.
- (3) The decision shall be supported by reasons and shall inform the Contractor of his or her rights as provided herein.
- (4) The authority contained in this clause shall not apply to a claim or dispute for penalties or forfeitures prescribed by statute or regulation which another District agency is specifically authorized to administer, settle, or determine.
- (5) This clause shall not authorize the Contracting Officer to settle, compromise, pay, or otherwise adjust any claim involving fraud.
- (c) The decision of the Contracting Officer shall be final and not subject to review unless an administrative appeal or action of judicial review is timely commenced by the District as authorized by D.C. Official Code § 2-309.04.
- (d) Pending final decision of an appeal, action or final settlement, the Contractor shall proceed diligently with performance of the contract in accordance with the decision of the Contracting Officer.

## ARTICLE 8. PROTESTS

Any actual or prospective bidder, offerer or contractor who is aggrieved in connection with the solicitation or award of a contract, must file with the D.C. Contract Appeals Board (Board) a protest no later than ten (10) business days after the basis of the protest is known or should have been known, whichever is earlier. A protest based on alleged improprieties in a solicitation which are apparent prior to bid opening or the time set for receipt of initial proposals shall be filed with the Board prior to bid opening or the time set for receipt of initial proposals. In procurement in which proposals are requested, alleged improprieties which do

not exist in the initial solicitation, but which are subsequently incorporated into this solicitation, must be protested no later than the next closing time for receipt of proposals following the incorporation. The protest shall be filed in writing, with the Contract Appeals Board, 717 14th Street, N.W., Suite 430, Washington, D.C. 20004. The aggrieved persons shall also mail a copy of the protest to the Contracting Officer for the solicitation.

#### **ARTICLE 9. PAYMENTS TO CONTRACTOR**

The District will pay the contract price or prices as hereinafter provided in accordance with District and Federal regulations.

The District will make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates approved by the Contracting Officer. The Contractor shall furnish a breakdown of the total Contract price showing the amount included therein for each principal category of the work, in such detail as requested, to provide a basis for determining progress payments. In the preparation of estimates the Contracting Officer, at his discretion, may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site may also be taken into consideration:

1. If such consideration is specifically authorized by the Contract;
2. If the Contractor furnishes satisfactory evidence that he has acquired title to such material, that it meets Contract requirements and that it will be utilized on the work covered by the Contract; and
3. If the Contractor furnishes to the Contracting Officer an itemized list.

The Contracting Officer at his/her discretion shall cause to be withheld retention in an amount sufficient to protect the interest of the District of Columbia. The amount shall not exceed ten percent of the partial payment. However, if the Contracting Officer, at any time finds that satisfactory progress is being made, he/she may authorize any of the remaining progress payments to be made in full or may retain from such remaining partial payments less than 10 percent thereof. Also, whenever work is substantially complete, the Contracting Officer, if he considers the amount retained to be in excess of the amount adequate for the protection of the District, at his/her discretion, may release to the Contractor all or a portion of such excess amount. Furthermore, on completion and acceptance of each separate building, public work, or other division of the Contract, on which the price is stated separately in the Contract, payment may be made thereof without the retention of percentage, less authorized deductions.

All material and work covered by progress payments made shall thereupon become the sole property of the District, but this provision shall not be construed as relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work, or as waiving the right of the District to require the fulfillment of all of the terms of the Contract.

Upon completion and acceptance of all work, the amount due the Contractor under the Contract shall be paid upon presentation of a properly executed voucher and after a release, if required, of all claims against the District arising by virtue of the Contract, other than claims in

stated amounts as may be specifically excepted by the Contractor from the operation of the release.

All payments by the District to the Contractor are subject to the provisions of D.C. Law 9-81 (District of Columbia Government Quick Payment Act of 1984 Amendment Act of 1992).

#### **ARTICLE 10. TRANSFER OR ASSIGNMENT**

Unless otherwise provided by law, neither the Contract nor any interest therein may be transferred or assigned by the Contractor to any other party without the written consent of the Contracting Officer nor without the written acceptance by the surety on the performance and payment bond securing the Contract of the assignee as the Contractor and the principal on such bond; and any attempted transfer as assignment not authorized by this Article shall constitute a breach of the Contract and the District may for such cause terminate the right of the Contractor to proceed in the same manner as provided in Article 5 herein, and the Contractor and his sureties shall be liable to the District for any excess cost occasioned the District thereby.

#### **ARTICLE 11. MATERIAL AND WORKMANSHIP**

- A. GENERAL** – Unless otherwise specifically provided in the Contract, all equipment, material, and articles incorporated in the work covered by the Contract shall be new and of the most suitable grade for the purpose intended. Unless otherwise specifically provided in the Contract, reference to any equipment, material, article, or patented process, by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor may use any equipment, material, article, or process which, in the judgment of the Chief Engineer, is equivalent to that named unless otherwise specified. The Contractor shall furnish to the Chief Engineer for his approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature, and rating of the mechanical and other equipment which the Contractor contemplates incorporating in the work. Machinery and equipment shall be in proper condition. When required by the Contract or when called for by the Chief Engineer, the Contractor shall furnish the Chief Engineer for approval full information concerning the material or articles which he contemplates incorporating in the work. When so directed, samples shall be submitted for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles installed or used without required approval shall be at the risk of subsequent rejection and subject to satisfactory replacement at Contractor's expense.
- B. SURPLUS MATERIALS USE** – Whenever specified in the Contract or authorized by the Chief Engineer that materials become the property of the Contractor, which by reference or otherwise shall include disposal of materials, it is understood that the Contractor accepts such materials "as is" with no further expense or liability to the District. If such material specified in the Contract will have a potential or real interest of value, the Contractor shall make allowance in the Contract to show such value.
- C. DISTRICT MATERIAL** – No materials furnished by the District shall be applied to any other use, public or private, than that for which they are issued to the Contractor. The full amount of the cost to the District of all materials furnished by the District to the Contractor and for which no charge is made, which are not accounted for by the Contractor to the satisfaction of the Chief Engineer, will be charged against the

Contractor and his sureties and may be deducted from any monies due the Contractor, and this charge shall be in addition to and not in lieu of any other liabilities of the Contractor whether civil or criminal. Materials furnished by the District for which a charge is made at a rate mentioned in the specifications will be delivered to the Contractor upon proper requisitions thereof and will be charged to his account.

- D. PLANT** – The Contractor shall at all times employ sufficient tools and equipment for prosecuting the various classes of work to full completion in the manner and time required. The Contractor shall at all times perform work in sufficient light and shall provide proper illumination, including lighting required for night work as directed, as a Contract requirement.

All equipment, tools, formwork, and staging used on the project shall be of sufficient size and in proper mechanical and safe condition to meet work requirements, to produce satisfactory work quality and to prevent injury to persons, the project, or adjacent property.

When methods and equipment are not prescribed in the Contract, the Contractor is free to use tools, methods, and equipment that he satisfactorily demonstrates will accomplish the work in conformity with Contract requirements.

If the Contractor desires to use a method or type of tool or equipment other than specified in the Contract, he shall request approval to do so; the request shall be in writing and shall include a full description of proposed methods, tools, and equipment and reasons for the change or substitution. Approval of substitutions and changed methods will be on condition that the Contractor will be fully responsible for producing work meeting Contract requirements. If, after trial use of the substituted methods, tools, and equipment, the Chief Engineer determines that work produced does not meet Contract requirements, the Contractor shall complete remaining work with specified methods, tools, and equipment.

- E. CAPABILITY OF WORKERS** – All work under the Contract shall be performed in a skillful and workmanlike manner. The Chief Engineer may require the Contractor to remove from the work any such employees as the Chief Engineer deems incompetent, careless, insubordinate, or otherwise objectionable, or whose continued employment on the work is deemed by the Chief Engineer to be contrary to the public interest. Such request will be in writing.
- F. CONFORMITY OF WORK AND MATERIALS** – All work performed and materials and products furnished shall be in conformity, within indicated tolerances, with lines, grades, cross sections, details, dimensions, materials, and construction requirements shown or intended by the drawings and specifications.

When materials, products, or work cannot be corrected, written notice of rejection will be issued. Rejected materials, products, and work shall be eliminated from the project and acceptably replaced at Contractor's expense. The Chief Engineer's failure to reject any portion of the project shall not constitute implied acceptance nor in any way release the Contractor from Contract requirements.

- G. UNAUTHORIZED WORK AND MATERIALS** – Work performed or materials ordered or furnished for the project deviating from requirements without written authority will be considered unauthorized and at Contractor's expense. The District is not obligated

to pay for unauthorized work. Unauthorized work and materials may be ordered removed and replaced at Contractor's expense.

## **ARTICLE 12. INSPECTION AND ACCEPTANCE**

Except as otherwise provided in the Contract, inspection and test by the District of material and workmanship required by the District shall be made at reasonable times and at the site of the work, unless the Chief Engineer determines that such inspection or test of material which is to be incorporated in the work shall be made at the place of production, manufacture, or shipment of such material. To the extent specified by the Chief Engineer at the time of determining to make off-site inspection or test, such inspection or test shall be conclusive as to whether the material involved conforms to Contract requirements. Such off-site inspection or test shall not relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of the District after acceptance of the completed work under the terms of the last paragraph of this Article, except as herein above provided.

The Contractor shall, without charge, replace any material and correct any workmanship found by the District not to conform to the Contract requirements, unless in the public interest the District consents to accept such material or workmanship with an appropriate adjustment in the Contract price. The Contractor shall promptly segregate and remove rejected material from the premises at Contractor's expense.

If the Contractor does not promptly replace rejected material or correct rejected workmanship, the District:

1. May, by contract or otherwise, replace such material and correct such workmanship and charge the cost thereof to the Contractor, or
2. May terminate the Contractor's Right to Proceed in accordance with Article 5 herein.

The Contractor shall furnish promptly, without additional cost to the District, all facilities, labor and material reasonably needed for performing such safe and convenient inspection and test as may be required by the Chief Engineer. All inspections and tests by the District shall be performed in such manner as not unnecessarily to delay the work. Special, full size, and performance tests shall be performed as described in the Contract. The Contractor shall be charged with any additional cost of inspection when material and workmanship are not ready for inspection at the time specified by the Contractor.

Should it be considered necessary or advisable by the Chief Engineer at any time before acceptance of the work, either in part or in its entirety, to make an examination of work completed, by removing or tearing out same, the Contractor shall, on request promptly furnish all necessary facilities, labor and material to do same. If such work is found to be defective or nonconforming in any material respect, due to the fault of the Contractor or his subcontractors, he shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, an equitable adjustment shall be made in the Contract price to compensate the Contractor for the additional services involved in such examination and reconstruction and, if completion of the work has been delayed thereby, he shall, in addition, be granted an equitable extension of time.

Unless otherwise provided in the Contract, acceptance by the District will be made as promptly as practicable after completion and inspection of all work required by the Contract. Acceptance shall be final and conclusive except as regards to latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the District's rights under any warranty or guaranty.

#### **ARTICLE 13. SUPERINTENDENCE BY CONTRACTOR**

The Contractor shall give his personal superintendence to the performance of the work or have a competent foreman or superintendent, satisfactory to the Contracting Officer, on the work site at all times during progress, with authority to act for him.

#### **ARTICLE 14. PERMITS AND RESPONSIBILITIES**

The Contractor shall, without expense to the District, be responsible for obtaining any necessary licenses, certificates, and permits, and for complying with any applicable Federal, State, and Municipal laws, codes, and regulations, in connection with the prosecution of the work. He shall be similarly responsible for all damages to persons or property that occur as a result of his fault or negligence. He shall take proper safety, health and environmental precautions to protect the work, the workers, the public, and the property of others. He shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire construction work, except for any completed unit of construction thereof which theretofore may have been accepted.

#### **ARTICLE 15. INDEMNIFICATION**

The Contractor shall indemnify and save harmless the District and all of its officers, agents, and servants against any and all claims or liability arising from or based on, or as a consequence or result of, any act, omission or default of the Contractor, his employees, or his subcontractors, in the performance of, or in connection with, any work required, contemplated, or performed under the Contract.

#### **ARTICLE 16. PROTECTION AGAINST TRESPASS**

Except as otherwise expressly provided in the Contract, the Contractor is authorized to refuse admission either to the premises or to the working space covered by the Contract to any person whose admission is not specifically authorized in writing by the Contracting Officer.

#### **ARTICLE 17. CONDITIONS AFFECTING THE WORK**

- A. GENERAL** – The Contractor shall be responsible for having taken steps reasonably necessary to ascertain the nature and location of the work, and the general and local conditions which can affect the work and the cost thereof. Any failure by the Contractor to do so will not relieve him from responsibility for successfully performing the work specified without additional expense to the District. The District assumes no responsibility for any understanding or representation concerning conditions made by any of its officers or agents prior to the execution of the Contract, unless such understanding or representation by the District is expressly stated in the Contract.
- B. WORK AND STORAGE SPACE** – Available work and storage space designated by the District shall be developed as required by the Contract or restored at completion of the

project by the Contractor to a condition equivalent to that existing prior to construction. No payment will be made for furnishing or restoration of any work and storage space.

If no area is designated or the area designated is not sufficient for the Contractor's operations, he shall obtain necessary space elsewhere at no expense or liability to the District.

- C. **WORK ON WEEKENDS, LEGAL HOLIDAYS, AND AT NIGHT** – No work shall be done at any time on Saturdays, Sundays or legal holidays, or on any other day before 7 a.m. or after 7 p.m., except with the written permission of the Contracting Officer or his designee, or as otherwise specified in the Contract, and pursuant to the requirements of the Police Regulations of the District.
- D. **EXISTING FEATURES** – Subsurface and topographic information including borings data, utilities data, and other physical data contained in the Contract or otherwise available, are not intended as representations or warranties but are furnished as available information. The District assumes no expense or liability for the accuracy of, or interpretations made from, existing features. The Contractor shall be responsible for reasonable consideration of existing features above and below ground which may affect the project.
- E. **UTILITIES AND VAULTS** – The Contractor shall take necessary measures to prevent interruption of service or damage to existing utilities within or adjacent to the project. It shall be the Contractor's responsibility to determine exact locations of all utilities in the field.

For any underground utility or vault encountered, the Contractor shall immediately notify the Chief Engineer and take necessary measures to protect the utility or vault and maintain its service until relocation by owner is accomplished. No additional payment will be made for the encountering of these obstructions.

In case of damage to utilities by the Contractor, either above or below ground, the Contractor shall restore such utilities to a condition equivalent to that which existed prior to the damage by repairing, rebuilding, or otherwise restoring as may be directed, at the Contractor's sole expense. Damaged utilities shall be repaired by the Contractor or, when directed by the Contracting Officer, the utility owner will make needed repairs at the Contractor's expense.

No compensation, other than authorized time extensions, will be allowed the Contractor for protective measures, work interruptions, changes in construction sequence, changes in methods of handling excavation and drainage, or changes in types of equipment used, made necessary by existing utilities, imprecise utility or vault information, or by others performing work within or adjacent to the project.

- F. **SITE MAINTENANCE** – The Contractor shall maintain the project site in a neat and presentable manner throughout the course of all operations, and shall be responsible for such maintenance until final acceptance by the District. Trash containers shall be furnished, maintained, and emptied by the Contractor to the satisfaction of the Chief Engineer. Excavated earthwork, stripped forms, and all other materials and debris not scheduled for reuse on the project shall be promptly removed from the site.

The Contracting Officer may order the Contractor to clean up the project site at any stage of work at no added expense to the District. If the Contractor fails to comply with this order, the Contracting Officer may require the work to be done by others and the costs will be charged to the Contractor.

Upon completion of all work and prior to final inspection, the Contractor shall clean up and remove from the project area and adjacent areas all excess materials, equipment, temporary structures, and refuse, and restore said areas to an acceptable condition.

- G. PRIVATE WORK** – Except as specifically authorized by the Contracting Officer, the Contractor shall not perform any private work abutting District projects with any labor, materials, tools, equipment, supplies, or supervision scheduled for the Contract until all work under the Contract has been completed. Contract materials used for any unauthorized purpose shall be subtracted from Contract amount.
- H. DISTRICT OF COLUMBIA NOISE CONTROL ACT OF 1977** – The Contractor shall be in strict compliance with D.C. Law 2-53, District of Columbia Noise Control Act of 1977 and all provisions thereof. Effective March 16, 1978. 24 D.C. Register 5293.

#### **ARTICLE 18. OTHER CONTRACTS**

The District may undertake or award other contracts for additional work and the Contractor shall fully cooperate with such other contractors and District employees and carefully coordinate his own work with such additional work as may be directed by the Contracting Officer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by District employees. The District assumes no liability, other than authorized time extension, for Contract delays and damages resulting from delays and lack of progress by others.

#### **ARTICLE 19. PATENT INDEMNITY**

Except as otherwise provided, the Contractor agrees to indemnify the District and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any Letters Patent of the United States (except Letters Patent issued upon an application which is now or may hereafter be, for reasons of national security, ordered by the Federal Government to be kept classified or otherwise withheld from issue) arising out of the performance of the Contract or out of the use or disposal by or for the account of the District, of supplies furnished or construction work performed hereunder.

#### **ARTICLE 20. COVENANT AGAINST CONTINGENT FEES**

The Contractor warrants that no persons or selling agency has been employed or retained to solicit or secure the Contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty the District shall have the right to terminate the Contract without liability or in its discretion to deduct from, the Contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage or contingent fee.

**ARTICLE 21. APPOINTMENT OF ATTORNEY**

The Contractor does hereby irrevocably designate and appoint the Clerk of the Superior Court of the District of Columbia and his successors in office as the true and lawful attorney of the Contractor for the purpose of receiving service of all notices and processes issued by any court in the District, as well as service of all pleadings and other papers, in relation to any action or legal proceeding arising out of or pertaining to the Contract or the work required or performed hereunder.

The Contractor expressly agrees that the validity of any service upon the said Clerk as herein authorized shall not be affected either by the fact that the Contractor was personally within the District and otherwise subject to personal service at the time of such service upon the said Clerk or by the fact that the Contractor failed to receive a copy of such process, notice, pleading or other paper so served upon the said Clerk, provided that said Clerk shall have deposited in the United States mail, certified and postage prepaid, a copy of such process, notice, pleading, or other papers addressed to the Contractor at the address stated in the Contract.

**ARTICLE 22. OFFICIALS NOT TO BENEFIT**

No Member of or Delegate to Congress or Mayor or Member of the City Council or officer or employee of the District shall be admitted to any share or part of the Contract or to any benefit that may arise therefrom and any contract entered into by any Contracting Officer in which he or any officer or employee of the District shall be personally interested shall be void, and no payment shall be made thereon by the Director or any officer thereof; but this provision shall not be construed to extend to the Contract if made with a corporation for its general benefit.

**ARTICLE 23. WAIVER**

No waiver of any breach of any provision of the Contract shall operate as a waiver of such provision or of the Contract or as a waiver of subsequent or other breaches of the same or any other provision of the Contract; nor shall any action or non-action by the Contracting Officer or by the Mayor be construed as a waiver of any provision of the Contract or of any breach thereof unless the same has been expressly declared or recognized as a waiver by the Contracting Officer or the Mayor in writing.

**ARTICLE 24. BUY AMERICAN**

- A. AGREEMENT** – In accordance with the Buy American Act (41 USC 10a-10d), and Executive Order 10582, December 17, 1954 (3 CFR, 1954-58 Comp., p. 230), as amended by Executive Order 11051, September 27, 1962 (3 CFR, 1059-63 Comp., p. 635), the Contractor agrees that only domestic construction material will be used by the Contractor, subcontractors, material men, and suppliers in the performance of the Contract, except for non-domestic material listed in the Contract.
- B. DOMESTIC CONSTRUCTION MATERIAL** – “Construction material” means any article, material, or supply brought to the construction site for incorporation in the building or work. An unmanufactured construction material is a “domestic construction material” if it has been mined or produced in the United States. A manufactured construction material is a “domestic construction material” if it has been manufactured in

the United States and if the cost of its components which have been mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. "Component" means any article, material, or supply directly incorporated in a construction material.

- C. DOMESTIC COMPONENT** – A component shall be considered to have been "mined, produced, or manufactured in the United States" regardless of its source, in fact, if the article, material, or supply in which it is incorporated was manufactured in the United States and the component is of a class or kind determined by the District to be not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality.
- D. FOREIGN MATERIAL** – When steel materials are used in a project a minimal use of foreign steel is permitted. The cost of such materials can not exceed one-tenth of one percent of the total project cost, or \$2,500.00, whichever is greater.

## ARTICLE 25. TAXES

**A. FEDERAL EXCISE** – Materials, supplies, and equipment are not subject to the Federal Manufacturer's Excise Tax, if they are furnished or used in connection with the Contract provided that title to such materials, supplies, and equipment passes to the District under the Contract. The Contractor shall in such cases furnish his subcontractors and suppliers with a purchaser's certificate in the form prescribed by the U.S. Internal Revenue Service.

**B. SALES AND USE TAXES** – Materials which are physically incorporated as a permanent part of real property are not subject to District of Columbia Sales and Use Tax. The Contractor shall, when purchasing such materials, furnish his suppliers with a Contractor's Exempt Purchase Certificate in the form prescribed in the Sales and Use Tax Regulations of the District of Columbia. Where the Contractor, subcontractor, or material supplier has already paid the Sales and Use Tax on materials, as prescribed above, the Sales and Use Tax Regulations of the District of Columbia permit the Contractor, subcontractor, or material man to deduct the sales or use tax on the purchase price of the same on his next monthly return as an adjustment. However, the Contractor, subcontractor, or material supplier must satisfy the Finance Officer, D.C., that no sum in reimbursement of such tax was included in the Contract or else that the District has received a credit under the Contract in an amount equal to such tax.

District of Columbia Sales and Use Tax shall be paid on any material and supplies, including equipment rentals, which do not become a physical part of the finished project. (See District of Columbia Sales and Use Tax Administration Ruling No. 6).

The Contractor, subcontractor or material supplier shall provide proof of compliance with the provisions of D.C. Law 9-260, as amended, codified in D.C. Code Title 46-103-Employer Contributions, prior to contract Award.

The Contractor, subcontractor or material supplier shall provide proof of compliance with the applicable tax filing and licensing requirements set forth in D.C. Code, Title 47-Taxation and Fiscal Affairs, prior to contract award.

**ARTICLE 26. SUSPENSION OF WORK**

The Contracting Office may order the Contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as he may determine to be appropriate for the convenience of the District.

If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed or interrupted by an act of the Contracting Officer in the administration of the Contract, or by his failure to act within the time specified in the Contract (or, if no time is specified, within a reasonable time), an adjustment will be made for an increase in the cost of performance of the Contract (excluding profit) necessarily caused by such unreasonable suspension, delay or interruption and the Contract modified in writing accordingly. However, no adjustment will be made under this Article for any suspension, delay or interruption to the extent:

1. That performance would have been so suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor, or
2. For which an equitable adjustment is provided or excluded under any other provision of the Contract.

No claim under this Article shall be allowed:

1. For any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and
2. Unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of such suspension, delay or interruption, but not later than the date of final payment under the Contract.

**ARTICLE 27. SAFETY PROGRAM**

- A. GENERAL** – In order to provide safety controls for the protection of the life and health of District and Contract employees and the general public; prevention of damage to property, materials, supplies, and equipment; and for avoidance of work interruptions in the performance of the Contract, the Contractor shall comply with all applicable Federal and local laws governing safety, health, and sanitation including the Safety Standards, Rules and Regulations issued by the American National Standards, U.S. Department of Labor, U.S. Department of Health and Human Services, D.C. Minimum Wage and Industrial Safety Board and the latest edition of “Manual of Uniform Traffic Control Devices” issued by the Federal Highway Administration.

The Contractor shall also take or cause to be taken such additional safety measures as the Contracting Officer may determine to be reasonably necessary.

The Contractor shall designate one person to be responsible for carrying out the Contractor’s obligation under this Article.

The Contractor shall maintain an accurate record of all accidents resulting in death, injury, occupational disease and/or damage to property, materials, supplies and equipment incidental to work performed under the Contract. Copies of these reports shall be furnished to the Contracting Officer within two working days after occurrence.

The Contracting Officer will notify the Contractor of any noncompliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

This Article is applicable to all subcontractors used under the Contract and compliance with these provisions by the subcontractors will be responsibility of the Contractor.

(In Contracts involving work of short duration or of nonhazardous character, the following Section B. will be deleted by Special Provision.)

**B. CONTRACTOR'S PROGRAM SUBMISSION** – Prior to commencement of the work, the Contractor shall:

1. Submit in writing to the Contracting Officer for his approval his program for complying with this Article for accident prevention.
2. Meet with the Contracting Officer's Safety Representative after submission of the above program to develop a mutual understanding relative to the administration of the overall safety program.

## **ARTICLE 28. RETENTION OF RECORDS**

Unless otherwise provided in the Contract, or by applicable statute, the Contractor, from the effective date of Contract and for a period of three years after final settlement under the Contract, shall preserve and make available to the District at all reasonable times at the office of the Contractor but without direct charge to the District, all his books, records, documents and other evidence, bearing on the costs and expenses of the Contractor under the Contract.

## **103.02 CONTRACT LABOR PROVISIONS**

The provisions of the Federal Labor Standards (construction contracts) of the Standard Contract Provisions, as amended or modified, that are applicable to the project are made a part of the construction contract. The Contractor shall keep fully informed of these articles which in any manner affect those engaged or employed on the work. He shall at all times observe and comply with these provisions. Penalty formulations of the Federal Labor Standards are prescribed in Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

### **103.02 A. STANDARD CONTRACT CLAUSES**

Each contract and subcontract at any tier "in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decoration of a public building or public work, or building" shall be subject to these labor provisions.

#### **1. MINIMUM WAGES**

- (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally

and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor, United States Department of Labor, hereinafter referred to as the Secretary of Labor, under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at the time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under (1)(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics, are considered wages paid to such laborers or mechanics subject to the provisions of 103.02A.1.(iv); also regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 103.02A.(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 103.02A (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

- (ii) (A) The Contracting Officer of the District of Columbia, Department of Transportation, hereinafter referred to as the Contracting Officer, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
- (1) Except with respect to helpers as defined in 29 CFR 5.2(n)(4), the work to be performed by the classification requested is not performed by a classification in the wage determination; and
  - (2) The classification is utilized in the area by the construction industry; and
  - (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination: and.
  - (4) With respect to helpers as defined in 29 CFR 5.2 (n)(4), such a classification prevails in the area in which the work is performed.

- (B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, agree with the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30 day period that additional time is necessary.
- (C) In the event the Contractor, or the laborers or mechanics to be employed in the classification or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.
- (D) The wage rate (including fringe benefits where appropriate) determined pursuant to (B) and (C) above shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.
- (iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.
- (iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any cost reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

## 2. WITHHOLDING

The Contracting Officer shall upon his or her own action or upon written request of an authorized representative of the United States Department of Labor withhold or cause to be withheld from the Contractor under this Contract or any other Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor

the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

### 3. PAYROLLS AND BASIC RECORDS

- (i) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly numbers of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approval programs shall maintain written evidence of the registration of apprenticeship programs, the certification of trainee programs, the registration of the apprenticeship programs, the certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.
- (ii) (A) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the District of Columbia Government if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the District of Columbia Government. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 5.5(a)(3)(i) of Regulations, 29 CFR Part 5. This information may be submitted in any form desired. Optional Form WH-347 may be purchased for this purpose from the Superintendent of Documents (FSN 029-005-0014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.
- (B) Each payroll submitted shall be accompanied by a “Statement of Compliance” signed by the Contractor or subcontractor or his or her agent who pays or

supervises the payment of the persons employed under the contract and shall certify the following:

- (1) That the payroll for the payroll period contains the information required to be maintained under 5.5(a)(3)(i) of Regulations, 29 CFR Part 5 and that such information is correct and complete;
  - (2) That each laborer or mechanic (including each helper, apprentice and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR Part 3;
  - (3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.
- (C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by (B) immediately above.
- (D) The Contractor shall notify the Contracting Officer in writing of all periods in which no work is performed. This notification applies to the prime Contractor and to all subcontractors.
- (E) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.
- (iii) The Contractor or subcontractor shall make the records required under 103.02A.3.(i) available for inspection, copying, or transcription by authorized representatives of the Contracting Officer or the United States Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

#### 4. APPRENTICES AND TRAINEES

- (i) **Apprentices.** Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an

apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeypersons on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman's hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

- (ii) **Trainees.** Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeypersons on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeypersons hourly rate specified in the applicable wage determination.

Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not

registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

- (iii) **Equal Employment Opportunity.** The utilization of apprentices, trainees, and journeymen under this part shall be in conformity with the equal employment opportunity requirements and Executive Order 11246, as amended and 29 CFR Part 30.

## **5. COMPLIANCE WITH COPELAND ACT REQUIREMENTS**

The Contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

## **6. SUBCONTRACTS**

The Contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the Contracting Officer may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5

## **7. CONTRACT TERMINATION: DEBARMENT**

A breach of the Contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a Contractor and a subcontractor as provided in 29 CFR 5.12.

## **8. COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REQUIREMENTS**

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3 and 5 are herein incorporated by reference in this Contract.

## **9. DISPUTES CONCERNING LABOR STANDARDS**

Disputes arising out of the labor standards provisions of this Contract shall not be subject to the general disputes clause of this Contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6 and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

## **10. CERTIFICATION OF ELIGIBILITY**

- a. By entering into this Contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a

person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

- b. No part of this Contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

### **103.02 B. CONTRACT WORK HOURS AND SAFETY STANDARDS**

The Agency Head shall cause or require the Contracting Officer to insert the following clauses set forth in B.1., 2., 3. and 4. in full in any contract subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 5.5(a) or 4.6 of Part 4 of 29 CFR. As used in this paragraph, the terms "laborers" and "mechanics" include watchpersons and guards.

#### **1. OVERTIME REQUIREMENTS**

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any work week in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

#### **2. VIOLATION; LIABILITY FOR UNPAID WAGES; LIQUIDATED DAMAGES**

In the event of a violation of the clause set forth in 103.02B.1., the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in B.1. above, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of eight hours or in excess of the standard workweek of forty hours without payment of the overtime wages required by the clauses set forth in B.1. above.

#### **3. WITHHOLDING FOR UNPAID WAGES AND LIQUIDATED DAMAGES**

The Contracting Officer shall upon his own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in B.2 above.

#### **4. SUBCONTRACTS**

The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in B.1 through B.4, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in B.1 through B.4.

##### **103.02 C. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT**

In addition to the clauses contained in 103.02B., in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 5.1, the Agency Head shall cause or require the Contracting Officer to insert a clause requiring that the Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watch men, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency head shall cause or require the Contracting Officer to insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Contracting Officer and the Department of Labor, and the Contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

##### **103.02 D. CONVICT LABOR (18 USC 436)**

Convict labor shall not be used on contract work unless otherwise provided by law.

##### **103.02 E. EQUAL OPPORTUNITY**

On contracts exceeding \$25,000.00, the Contractor shall not discriminate against any employee or applicant for employment because of race, color, age, sex, religion or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, age, sex, religion or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this Article. The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, age, sex, religion or national origin.

The Contractor shall send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Contracting Officer, advising the said labor union or worker's representative of the Contractor's commitments under this Article, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The Contractor shall permit access to his books, records and accounts by the Contracting Officer and the Office of Local Business Development or their agents, for purposes of investigation to ascertain compliance with this Article.

In the event of the Contractor's non-compliance with this Article, the Contract may be canceled in whole or in part and the Contractor may be declared ineligible for further District contracts.

The Contractor shall include the provisions of this Article in every subcontract unless exempted by rules, regulations or orders of the District, so that such provisions will be binding upon each subcontractor or vendor. The Contractor shall take such action with respect to any subcontract as the Contracting Officer may direct as a means of enforcing such provisions, including sanctions for non-compliance; provided, however, that in the event the Contractor becomes involved in, or is threatened with litigation with a subcontractor or vendor as a result of such directions by the Contracting Officer, the Contractor may request the District to enter into such litigation to protect the interest of the District.

### **103.02 F. NONSEGREGATED FACILITIES**

The Contractor certifies that he does not and will not maintain or provide for his employment any segregated facility at any of his establishments; that he does not and will not permit his employees to perform their services at any location under his control where segregated facilities are maintained; and that he will obtain and retain identical certifications from proposed subcontractors prior to award of subcontracts.

"Segregated facilities" shall mean any waiting room, work area, wash and rest rooms, restaurant and other eating area, time clock, locker room and other storage or dressing area, parking lot, drinking fountain, recreation or entertainment area, transportation and housing facility provided for employees which is segregated by explicit directive or is segregated on the basis of race, color, age, sex, religion or national origin, because of habit, local custom, or otherwise.

Penalty for violation or making false statements is prescribed in 18 USC 1001.

### **103.02 G. BUSINESS EQUAL EMPLOYMENT OPPORTUNITY**

**A. GENERAL.** An award cannot be made to any Bidder who has not satisfied the equal opportunity requirements as set forth by the Office of Local Business Development.

#### **B. OPEN MARKET SOLICITATIONS**

##### **1. Preference for Local Businesses, Disadvantaged Businesses, Resident Business Ownerships or Business Operation in an Enterprise Zone.**

- a. General Preferences.** Under the provisions of D.C. Law 13-169, "Equal Opportunity for Local, Small or Disadvantaged Business Enterprises Amendment Act of 2000", (the "Act"), the District shall apply preferences in evaluating offers from businesses that are local, disadvantaged, resident business ownership or located in an enterprise zone of the District of Columbia.

For evaluation purposes, the allowable preferences under the Act for open market procurements are as follows:

1. Four percent reduction in the bid price or the addition of four points on a 100-point scale for a local business enterprise (LBE) certified by the Local Business Opportunity Commission (LBOC);
2. Three percent reduction in the bid price or the addition of three points on a 100-point scale for a disadvantaged business enterprise (DBE) certified by the Local Business Opportunity Commission.
3. Three point reduction in the bid price or the addition of three points on a 100-point scale for a resident ownership (RBO), as defined in Section 2 (a) (8A) of the Act, and certified by the Local Business Opportunity Commission; and,
4. Two percent reduction in the bid price or the addition of two points on a 100-point scale for a business located in an enterprise zone, as defined in Section 2 (5) of D.C. Law 12-268 and in 27 DCMR 899, 39 DCR 9087-9088 (December 4, 1992).

Any Prime Contractor that is an LBE certified by the LBOC will receive a four percent (4%) reduction in bid price for a bid submitted by the LBE in response to an Invitation for Bids (IFB) or the addition of four points on a 100-point scale added to the overall score for bids submitted by the LBE in response to a Request for Proposal.

Any Prime Contractor that is a DBE certified by the LBOC will receive a three percent (3%) reduction in the bid price submitted by the DBE in response to an IFB or the addition of three points on a 100-point scale added to the overall score of proposals submitted by the DBE in response to a RFP.

Any Contractor that is a RBO certified by the LBOC will receive a three percent (3%) reduction in the bid price for a bid submitted by the RBO in response to an IFB or the addition of three points on a 100 point scale added to the overall score for proposals submitted by the RBO in response to a RFP.

Any Prime Contractor that is a business enterprise located in an enterprise zone will receive a two percent (2%) reduction in bid price for a bid submitted by such business enterprise in response to an IFB or the addition of two points on a 100 point scale added to the overall score for proposals submitted by such business in response to a RFP.

**b. Preferences for Subcontracting in Open Market solicitations with No LBE, DBE, or RBO Subcontracting Set Aside.** The preferences for subcontracting in open market solicitations where there is no LBE, DBE, or RBO subcontracting set aside are as follows:

1. If the Prime Contractor is not a certified LBE, certified DBE, certified RBO or a business enterprise in an enterprise zone, the District will award the above stated preferences by reducing the bid price or increasing the points proportionally based on the total dollar value of the bid or proposal that is designated by the Prime Contractor for subcontracting with a certified LBE, DBE, RBO or business located in an enterprise zone.
2. If the Prime Contractor is a joint venture that is not a certified LBE, certified DBE or certified RBO joint venture, or if the Prime Contractor is a joint venture that includes a business in an enterprise zone but such business located in an enterprise zone does not own and control at least fifty-one percent (51%) of the joint venture, the District will award the above-stated preferences by

reducing the bid price or by increasing the points proportionally in the proposal based on the total dollar value of the bid or proposal that is designated by the Prime Contractor for a certified LBE, DBE, RBO or business located in an enterprise zone, for participation in the joint venture.

EXAMPLE: If a non-certified Prime Contractor subcontracts with a certified local business enterprise for a percentage of the work to be performed on an RFP, the calculation of the percentage points to be added during evaluation would be according to the following:

$(\text{Amount of Subcontract} / \text{Amount of Contract}) \times 4 = \text{Points Awarded for Evaluating LSDBE Subcontracting}$ , where 4 is equivalent to four points on a 100 point scale.

The maximum total preference under the Act of this type of procurement is twelve percent (12%) for bids submitted in response to an IFB or the equivalent of twelve (12) points on a 100 point scale for proposals submitted in response to an RFP. Any Prime Contractor receiving the full bid price reduction or point addition to its overall score for a particular preference will not receive any additional bid price reduction or points for further participation on a subcontracting level for that particular preference.

However, the Prime Contractor shall receive a further proportional bid price reduction or point addition on a different preference for participation on a subcontracting level for that different preference. For example, if an LBE Prime Contractor receives the four percent bid price reduction or the equivalent of four points on a 100 point scale, the LBE Prime Contractor does not receive a further price reduction or additional points if such contractor proposes subcontracting with an LBE. However, if this same LBE Prime Contractor proposes subcontracting with a DBE, the LBE Prime Contractor receives a further proportional bid price reduction or point addition for the DBE participation at the subcontracting level.

- c. Preferences for Open Market Solicitations with LBE, DBE or RBO Subcontracting Set Aside.** If the solicitation is an open market solicitation with LBE, DBE or RBO subcontracting set-aside, the Prime Contractor will receive the LBE, DBE or RBO preferences only if it is a certified LBE, DBE or RBO. There shall be no preference awarded for subcontracting by the Prime Contractor with a LBE, DBE or RBO, even if the Prime Contractor proposes LBE, DBE or RBO subcontracting above the subcontracting levels required by the solicitation. However, the Prime Contractor shall be entitled to the full preference for business located in an enterprise zone if it is a business located in an enterprise zone or a proportional preference if the Prime Contractor subcontracts with a business located in an enterprise zone.

The maximum total preference under the Act for this type of procurement is twelve percent (12%) for bids submitted in response to an IFB or the equivalent of twelve (12) points on a 100 point scale for proposals submitted in response to an RFP.

**2. Preferences for Certified Joint Ventures Including Local or Disadvantaged Business or Resident Business Ownership.**

When the LBOC-certified joint venture includes a local business enterprise (LBE), disadvantaged business (DBE) or a resident business ownership (RBO), and the LBE, DBE or RBO owns and controls at least fifty-one percent (51%) of the venture, the joint venture will receive the preferences as if it were a certified LBE, DBE or RBO.

### **3. Preference for Joint Ventures Including Businesses Located in an Enterprise Zone.**

When a joint venture includes a business located in an enterprise zone, and such business located in an enterprise zone owns and controls at least fifty-one percent (51%) of the venture, the joint venture will receive the preferences as if it were a business located in an enterprise zone.

### **4. Penalties and Misrepresentations.**

Any material misrepresentation on the sworn notarized self-certification form could result in termination of the contract, the contractor's liability for civil and criminal action in accordance with the Act, D.C. Law 12-268, and other District laws, including debarment.

### **5. Local, Small and Disadvantaged Business Enterprise Subcontracting.**

a. When a Prime Contractor is certified by the Office of Local Business Development as a local, small or disadvantaged business or a resident business ownership, the Prime Contractor shall perform at least fifty percent (50%) of the contracting effort, excluding the cost of materials, goods, and supplies with its own organization resources, and if it subcontracts, fifty percent (50%) of the subcontracting effort, excluding the cost of materials, goods and supplies shall be with certified local, small or disadvantaged business enterprises and resident business ownerships, unless a waiver is granted by the Contracting Officer, with prior approval and consent of the Director of LBOC under the provisions of 27 DCMR 805, 39 DCR 5578-5580 (July 24, 1992).

b. By submitting a signed bid or proposal, the Prime Contractor certifies that it will comply with the requirements of this clause.

## **C. OPEN MARKET SOLICITATIONS WITH LBE, DBE OR RBO SUBCONTRACTING SET-ASIDE.**

Under the provisions of 27DCMR 801.2(b), 39 DCR 5571 (July 24, 1992), a percentage, defined in the contract documents, of the total dollar value of a contract may be set aside for performance through subcontracting with local business enterprises, disadvantaged business enterprises, or resident business ownerships. Any Prime Contractor responding to a solicitation of this type shall submit with its bid or proposal a notarized statement detailing its subcontracting plans (see 103.02 H (B) (1) and 103.02 H (B) (2)). Once the plan is approved by the Contracting Officer, changes will occur only with the prior written approval of the Contracting Officer.

## **D. OPEN MARKET SOLICITATIONS WITH LBE, DBE OR RBO SUBCONTRACTING OR SUBCONTRACTING WITH BUSINESS LOCATED IN AN ENTERPRISE ZONE.**

### **1. Subcontracting Plan**

A notarized statement detailing a subcontracting plan shall be submitted, as part of the bid or proposal, by any Prime Contractor seeking a preference on the basis of proposed subcontracting with LBE, DBE, RBO or business located in an enterprise zone; and by any Prime Contractor responding to a solicitation in which there is a LBE, DBE, RBO subcontracting set aside. Each subcontracting plan shall include the following:

- a. A description of the goods and services to be provided by the LBE, DBE, or RBo of business located in the enterprise zone;
- b. If the Prime Contractor is seeking a preference on the basis of proposed subcontracting with a LBE, DEBE, RBO or a business located in an enterprise zone, a statement of the dollar amount, by type of business enterprise, of the bid or proposal that is designated by the Prime Contractor for a LBE, DEBE, RBO or business located in an enterprise zone;
- c. If the solicitation contains a LBE, DBE, or RBO subcontracting set-aside, a statement of the dollar value, by type of business enterprise, of the bid or proposal that pertains to the subcontracts to be performed by the LBEs, DBEs, RBOs or businesses located in the enterprise zone;
- d. The names and addresses of all proposed subcontractors who are LBEs, DBEs, RBOs or businesses located in an enterprise zone;
- e. The name of the individual employed by the Prime Contractor who will administer the subcontracting plan, and a description of the duties of the individual;
- f. A description of the efforts the Prime Contractor shall make to ensure that LBEs, DBEs, RBOs and businesses located in an enterprise zone will have an equitable opportunity to compete for subcontracts;
- g. In all subcontracts that offer further subcontracting opportunities, assurances that the Prime Contractor shall include a statement, approved by the Contracting Officer, that the subcontractor shall adopt a subcontracting plan similar to the subcontracting plan required by the contract;
- h. Assurances that the Prime Contractor shall cooperate in any studies or surveys that may be required by the Contracting Officer, and submit periodic reports, as requested by the Contracting Officer, to allow the District to determine the extent of compliance by the Prime Contractor with the subcontracting plan;
- i. List the type of records the Prime Contractor shall maintain to demonstrate procedures adopted to comply with the requirements set forth in the subcontracting plan, and include assurances that the Prime Contractor shall make such records available for review upon the District's request; and
- j. A description of the Prime Contractor's recent effort to locate LBEs, DBEs, RBOs and businesses located in an enterprise zone and to award subcontracts to them.

## **2. Liquidated Damages**

- a. If during the period of performance on a contract, the Contractor fails to comply with the subcontracting plan submitted in accordance with the requirements of the contract and 27 DCMR 804.9, 39 DCR 5578 (July 24, 1992), and as approved by the Contracting Officer, the Contractor shall pay the District liquidated damages in the amount as defined in the contract documents for each day the Contractor fails to comply with the subcontracting plan, unless the Contracting Officer determines that the Contractor made a good faith effort to comply with the subcontracting plan in accordance with subparagraph (b) below.

- b. Prior to assessing any liquidated damages under this provision, the Contracting Officer shall issue a written notice informing the Contractor that it is not in compliance with the subcontracting plan and set forth the areas of non-compliance. The written notice from the Contracting Officer shall provide the Contractor with ten (10) calendar days from receipt of the written notice to correct any areas of non-compliance or to demonstrate that the Contractor has used good faith efforts to comply with the subcontracting plan. If the Contractor fails to correct any areas of non-compliance or demonstrate good faith efforts within the ten day period, the Contracting Officer shall assess liquidated damages beginning on the first day after the end of the ten day period.
- c. If failure to comply with the subcontracting plan is such that the Contracting Officer determines it to be a material breach of the contract and terminates the contract under the Default Clause of the Standard Contract Provisions, the Contractor shall be liable for aforementioned liquidated damages accruing until the time the District may reasonably obtain similar goods and services.

**E. PROCUREMENTS RESTRICTED TO THE SMALL BUSINESS ENTERPRISE (SBE) SET-ASIDE MARKET**

**1. Designation of Solicitation for the Small Business Set Aside Market Only**

Invitations for Bids or Requests for Proposals under this type of procurement are designated for certified small business enterprise (SBE) offerors only under the provisions of “The Equal Opportunity for Local, Small and Disadvantaged Business Enterprises of 1998, D.C. Law 12-268 (the “Act”) and “The Equal Opportunity for Local, Small and Disadvantaged Business Opportunity Amendment Act of 2000” D.C. Law 13-169 (the “Amendment”).

A SBE must be certified as small in the procurement category as defined in the advertisement for a given solicitation in order to be eligible to submit a bid or proposal in response to that solicitation.

**2. Subcontracting by Certified Small Business Enterprise**

- a. When a Prime Contractor is certified by the Local Business Opportunity Commission (LBOC) as a small business, the Prime Contractor shall perform at least fifty percent (50%) of the contracting effort, excluding the cost of materials, goods and supplies, with its own organization and resources, and if it subcontracts, fifty percent (50%) of the subcontracting effort, excluding the cost of materials, goods and supplies shall be with certified local, small, and disadvantaged business enterprises and resident business ownerships unless a waiver is granted by the Contracting Officer, with the prior approval and consent of the Director of the LBOC, under the provisions of 27 DCMR 805, 39 DCR 9050-9060 (December 4, 1992).
- b. By submitting a signed bid or proposal, the Prime Contractor certifies that it will comply with the requirements of paragraph (a) of this clause.

**3. Vendor Submission of Certification**

Any vendor seeking to submit a bid or proposal as a small business enterprise (SBE) in response to a solicitation must submit one of the following at the time of, and as part of its bid or proposal:

- a. A copy of the SBE letter of certification from the Local Business Opportunity Commission;, or
- b. A copy of a sworn notarized Self-Certification Form prescribed by the LBOC along with an acknowledgement letter issued by the Director of LBOC.

Bids or proposals from vendors that are not certified as small business enterprises through one of the means described in this section will not be considered. Bidders or offerors must submit the required evidence of certification or self-certification at the time of submission of bids or proposals.

The Self-Certification Package will be included as an attachment in procurement documents.

In order to be eligible to submit a bid or proposal, or to receive any preferences under this type of solicitation, any vendor seeking self-certification must complete and submit Self-Certification forms to:

Department of Human Rights and Local Business Development  
ATTN: LSDBE Certification Program  
441 Fourth Street, N.W. Suite 970 N  
Washington, D.C. 20001

All vendors are encouraged to contact the Local, Small and Disadvantaged Business Enterprises Certification Program at (202) 727-3900 if additional information is required on certification procedures and requirements.

#### **4. Penalties for Misrepresentation**

Any material misrepresentation on the sworn notarized self-certification form could result in termination of the contract, the Contractor's liability for civil and criminal action in accordance with the Act and other District laws, including debarment.

#### **5. Preferences in the SBE Set-Aside Market**

For evaluation purposes, a certified small business enterprise (SBE) that is also certified by the LBOC as a local business enterprise (LBE) will receive a four percent (4%) reduction in the bid price for a bid submitted in response to an Invitation for Bids (IFB) or the addition of four points on a 100-point scale added to the overall score for proposals submitted in response to a Request for Proposals (RFP).

A certified small business that is also certified by the LBOC as a disadvantaged business enterprise (DBE) will receive a three percent (3%) reduction in the bid price submitted in response to an IFB or the addition of three points on a 100-point scale added to the overall score for proposals submitted in response to an RFP.

A certified small business that is also certified by the LBOC as a resident business ownership (RBO), as defined in Section 2(a)(8A) of the Amendment, will receive three percent (3%) reduction in the bid price for a bid submitted in response to an IFB or the addition of three points on a 100-point scale added to the overall score for proposals submitted in response to a RFP.

A certified small business that is also certified by the LBOC as a business in an enterprise zone, as defined in Section 2(5) of the Act and in 27DCMR 899, 39 DCR

9087-9088 (December 4, 1992), will receive two percent (2%) reduction in the bid price for a bid submitted in response to an IFB or the addition of two points on a 100-point scale added to the overall score for proposals submitted by such business enterprise in response to an RFP.

The maximum total preference under the SBE Set-Aside Program is twelve percent (12%) reduction in the bid price for bids submitted in response to an IFB or the addition of 12 points on a 100-point scale added to the overall score for proposals submitted in response to an RFP. The District shall award the preference points based only on whether the SBE Prime Contractor is also a LBE, DBE, RBO or business located in an enterprise zone. There shall be no points awarded for subcontracting by the SBE Prime Contractor to a LBE, DBE, RBO or business located in an enterprise zone.

If the Prime Contractor is a certified SBE joint venture that is also certified as a LBE, DBE, or RBO joint venture, or if the Prime Contractor is a certified SBE joint venture that includes a business located in an enterprise zone and such business owns and controls at least fifty-one percent (51%) of the joint venture, the Prime Contractor will receive the preference as if it were a LBE, DBE, RBO or business located in an enterprise zone. There shall be no more points awarded for any other joint venture participation by LBEs, DBEs, RBOs or businesses located in an enterprise zone.

## **6. SBE Joint Ventures**

A joint venture between a small business enterprise (as defined under Section 2(6) of the Act and implementing regulations) and another entity shall be eligible to submit a bid or proposal in response to a SBE set-aside solicitation if the joint venture is certified by LBOC under the provisions of 27 DCMR 817, 39 DCR 9072-9075 (December 4, 1992) or is self-certified under DCMR 818, 39 DCR 9075-9076 (December 4, 1992).

The LBOC shall certify a joint venture when the SBE affiliates itself with another entity to form a joint venture for a SBE set-aside solicitation if:

- (a) The non-SBE partner demonstrates to the LBOC that its size does not exceed the size limitations set forth in the Act; or
- (b) The LBOC determines that the certification of the joint venture with an entity exceeding the size limitation of the Act would not be detrimental to the SBE set-aside program.

## **103.02 H. WEEKLY COMPLIANCE STATEMENT**

The Contractor and each subcontractor engaged in the construction, prosecution, completion or repair of any public building or public work shall furnish each week a statement with respect to the wages paid each of his employees engaged on work covered by these Labor Provisions during the preceding weekly payroll period. The statement shall be executed by the Contractor or subcontractor, or by an authorized officer or employee of the Contractor or subcontractor, who supervised the payment of wages, and shall be on the form entitled "Weekly Statement of Compliance" (Form No. DC 2640-11).

## **103.03 EQUAL EMPLOYMENT OPPORTUNITY RESPONSIBILITIES**

- A. GENERAL.** Equal employment opportunity requirements not to discriminate and to take affirmative action to assure equal employment opportunity as required by Executive Order 11246 and Executive Order 11375 are set forth in Required Contract Provisions (Form FHWA

-1273 or 1316, as appropriate) and these Special Provisions which are imposed pursuant to Section 140 of Title 23, U.S.C., as established by Section 22 of the Federal-Aid Highway Act of 1968. The requirements set forth in these Special Provisions shall constitute the specific affirmative action requirements for project activities under this contract and supplement the equal employment opportunity requirements set forth in the Required Contract Provisions.

The Contractor will work with the State highway agencies and the Federal Government in carrying out equal employment opportunity obligations and in the review of his/her activities under the contract.

The Contractor and all his/her subcontractors holding subcontracts not including material suppliers, of \$10,000 or more, will comply with the following minimum specific requirement activities of equal employment opportunity: (The equal employment opportunity requirements of Executive Order 11246, as set forth in Volume 6, Chapter 4, Section 1, Subsection 1 of the Federal-Aid Highway Program Manual, are applicable to material suppliers as well as contractors and subcontractors.) The contractor will include these requirements in every subcontract of \$10,000 or more with such modification of language as is necessary to make them binding on the subcontractor.

- B. EQUAL EMPLOYMENT OPPORTUNITY POLICY.** The Contractor will accept as his/her operating policy the following statement which is designed to further the provision of equal employment opportunity to all persons without regard to their race, color, religion, sex or national origin, and to promote the full realization of equal employment opportunity through a positive continuing program:

“It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, or national origin. Such action shall include: employment, upgrading, demotion or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training.”

- C. EQUAL EMPLOYMENT OPPORTUNITY OFFICER.** The Contractor will designate and make known to the Contracting Officer an equal employment opportunity officer (hereinafter referred to as the EEO Officer) who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of equal employment opportunity and who must be assigned adequate authority and responsibility to do so.

- D. DISSEMINATION OF POLICY.** All members of the Contractor’s staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the Contractor’s equal employment opportunity policy and contractual responsibilities to provide equal employment in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

1. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the Contractor’s equal employment opportunity policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer or other knowledgeable company official.

2. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer or other knowledgeable company official, covering all major aspects of the Contractor's equal employment opportunity obligations within thirty days following their reporting for duty with the Contractor.
3. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer or appropriate company official in the Contractor's procedures for locating and hiring minority group employees.

In order to make the Contractor's equal employment opportunity policy known to all employees, prospective employees and potential sources of employees, i.e., schools, employment agencies, labor unions (where appropriate), college placement officers, etc., the Contractor will take the following actions:

1. Notices and posters setting forth the Contractor's equal employment opportunity policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.
2. The Contractor's equal employment opportunity policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, other appropriate means.

- E. RECRUITMENT.** When advertising for employees, the Contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be published in newspapers or other publications having a large circulation among minority groups in the area from which the project work force would normally be derived.

The Contractor shall, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority group applicants, including, but not limited to, State employment agencies, schools, colleges and minority group organizations. To meet this requirement, the Contractor will, through his EEO Officer, identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group applicants may be referred to the Contractor for employment consideration.

In the event the Contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with equal employment opportunity contract provisions. (The U.S. Department of Labor has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the Contractors to do the same, such implementation violates Executive Order 11246, as amended.)

The Contractor shall encourage his present employees to refer minority group applicants for employment by posting appropriate notices or bulletins in areas accessible to all such employees. In addition, information and procedures with regard to referring minority group applicants will be discussed with employees.

- F. PERSONNEL ACTIONS.** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring,

upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, or national origin. The following procedures shall be followed:

1. The Contractor will conduct periodic inspections of project sites to ensure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.
2. The Contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.
3. The Contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.
4. The Contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with his obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the Contractor will inform every complainant of all of his avenues of appeal.

#### **G. TRAINING AND PROMOTION.**

1. The Contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.
2. Consistent with the Contractor's work force requirements and as permissible under Federal and State regulations, the Contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event the Training Special Provision is provided under this contract, this subparagraph will be superseded as indicated in Attachment 2 of the Special Provisions.
3. The Contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.
4. The Contractor will periodically review the training and promotion potential of minority group and women employees and will encourage eligible employees to apply for such training and promotion.

**H. UNIONS.** If the Contractor relies in whole or in part upon unions as a source of employees, the Contractor will use his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the Contractor either directly or through a contractor's association acting as agent will include the procedures set forth below:

1. The Contractor will use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and

women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.

2. The Contractor will use best efforts to incorporate an equal employment opportunity clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, or national origin.
3. The Contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the Contractor, the Contractor shall so certify to the State highway department and shall set forth what efforts have been made to obtain such information.
4. In the event the union is unable to provide the Contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the Contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, or national origin; making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The U.S. Department of Labor has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the Contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such Contractor shall immediately notify the State highway agency.

#### **I. SUBCONTRACTING.**

1. The Contractor will use his best efforts to solicit bids from and to utilize minority group subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of minority-owned construction firms from State highway agency personnel.
2. The Contractor will use his best efforts to ensure subcontractor compliance with their equal employment opportunity obligations.

#### **J. RECORDS AND RECEIPTS.**

1. The Contractor will keep such records as are necessary to determine compliance with the contractor's equal employment opportunity obligations. The records kept by the contractor will be designed to indicate:
  - a. The number of minority and non-minority group members and women employed in each work classification on the project.
  - b. The progress and efforts being made in cooperation with unions to increase employment opportunities for minorities and women (applicable only to contractors who rely in whole or in part on unions as a source of their work force).
  - c. The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees, and

- d. The progress and efforts being made in securing the services of minority group subcontractors or subcontractors with meaningful minority and female representation among their employees.
2. All such records must be retained for a period of three years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the State highway agency and the Federal Highway Administration.
3. The Contractors will submit an annual report to the State highway agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form PR 1391. If on-the-job training is being required by "Training Special Provision", the contractor will be required to furnish Form FHWA 1409.

### **103.04 EMPLOYEE TRAINING REQUIREMENTS**

When referenced in the Contract Special Provisions, this article shall be utilized in the implementation of 23 U.S.C. Pt. 230, Subpt. A, App. B.

The Contractor shall provide on-the-job training aimed at developing full journeyworkers in the type of trade or job classification involved.

In the event that a Contractor subcontracts a portion of the contract work, he/she shall determine how many, if any, of the trainees are to be trained by the subcontractor, provided, however, that the Contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The Contractor shall also ensure that this training special provision is made applicable to such subcontract. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training.

The number of trainees shall be distributed among the work classifications on the basis of the Contractor's needs and the availability of journeyworkers in the various classifications with a reasonable area of recruitment. Prior to commencing construction, the Contractor shall submit to the Department for approval the names, addresses and social security numbers of the trainees to be trained in each selected classification. Furthermore, the Contractor shall specify the starting time for training in each of the classifications. The Contractor will be credited for each trainee employed by him/her on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter.

Training and upgrading of minorities and women toward journey worker status is a primary objective of this Training Special Provision. Accordingly, the Contractor shall make every effort to enroll minority trainees and women (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent that such persons are available within a reasonable area of recruitment. The Contractor will be responsible for demonstrating the steps that he/she has taken in pursuance thereof, prior to a determination as to whether the Contractor is in compliance with this Training Special Provision. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

No employee shall be employed as a trainee in any classification in which he/she has successfully completed a training course leading to journeyworker status or in which he/she has been employed as a journeyworker. The Contractors should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used, the Contractors records should document the findings in each case.

The minimum length and type of training for each classification will be as established in the training program approved by the District of Columbia, Department of Transportation and the Federal Highway Administration. The Department and the Federal Highway Administration shall approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the Contractor and to qualify the average trainee for journeyworker status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau and Training programs approved but not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training shall also be considered acceptable provided they are being administered in a manner consistent with the equal employment obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from the State prior to commencing work on the classification covered by the program. It is the intention of these provisions that training is to be provided in the construction crafts rather than clerk-typists or secretarial-type positions. Training is permissible in lower level management positions such as office engineers, estimators, timekeepers, etc., where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the division office. Some off-site training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

The Contractor will be reimbursed in the amount indicated in the unit price column of the Pay Item Schedule in the Bid Form and Proposals for each hour of training. As verified by the Chief Engineer, reimbursement will be made for training persons in excess of the number specified herein. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other does not specifically prohibit the Contractor from receiving other reimbursement. Reimbursement for off-site training indicated above may only be made to the Contractor where he/she does one or more of the following and the trainees are concurrently employed on a Federal-aid project; contributes to the cost of the training, provides the instruction to the trainee or pays the trainees wages during the off-site training period.

No payment shall be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyworker, is caused by the Contractor and evidences a lack of good faith on the part of the Contractor in meeting the requirements of Training Provision. It is normally expected that a trainee will begin his/her training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training opportunities exist in his/her work classification or until he/she has completed his training program. It is not required that all trainees be on board for the entire length of the contract. A Contractor will have fulfilled his/her responsibilities under the Training Provision if he/she has provided acceptable training to the number of trainees

specified. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period.

Trainees will be paid at least 60 percent of the appropriate minimum journeyworkers rate specified in the contract for the first half of the training period, 75 percent for the third quarter of the training period, and 90 percent for the last quarter of the training period, unless apprentices or trainees in an approved existing program are enrolled as trainees on this project. In that case, the appropriate rates approved by the Departments of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification who are covered by the Training Provision.

The Contractor shall furnish the trainee a copy of the program he/she will follow in providing the training. The Contractor shall provide each trainee with a certification showing the type and length of training satisfactorily completed.

The Contractor will provide for the maintenance of records and furnish periodic reports documenting his/her performance under this article.

## 104 SCOPE OF WORK

### 104.01 INTENT OF CONTRACT

The intent of the contract is to provide for the construction and completion in every detail of the work described. The Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work in accordance with the plans, specifications and terms of the contract.

### 104.02 MAINTENANCE OF TRAFFIC

Unless otherwise specified in the contract documents, the roadway, while undergoing improvements shall be kept open to traffic by the Contractor. The Contractor shall keep the portion of the project being used by the public in such condition that the traffic will be adequately protected and accommodated and the roadway smooth and free of potholes. Snow removal will not be required of the Contractor. The Contractor shall provide, erect, maintain and remove all barricades, warning signs, delineators, and flaggers in accordance with the MUTCD and 616 Traffic Control of these specifications. Failure by the Contractor to open traffic lanes when required and to maintain designated lanes open to traffic shall be subject to \$500.00 fine per hour/per occurrence, as determined by the Chief Engineer. All fines levied for such violations shall be deducted from the next partial payment and shall not be refundable.

- (A) **TRAFFIC FLOW RESTRICTIONS.** On arterial streets the full roadway width shall be opened to traffic between the hours of 6:30 and 9:30 AM and between 3:30 and 6:30 PM, Monday through Friday, exclusive of legal holidays, and at all times when work is not actually in progress. Unless otherwise provided, during these restricted hours, work may be performed provided that the full roadway width remains opened to traffic. During other times traffic shall be maintained as directed. Traffic on streets other than arterials shall be maintained as directed. No materials nor equipment shall be placed or stored on city travelways when work is not actually in progress, unless specifically authorized.

If it becomes necessary to remove illegally parked or abandoned vehicles, the Contractor, with the assistance of a Metropolitan Police Department Officer, shall be responsible for moving any such vehicle at no expense to the District.

Pedestrian access to abutting properties, and vehicular access for ambulances, police, fire and other emergency equipment shall be maintained. When access is to be temporarily curtailed, the Contractor shall be responsible for giving adequate notice to the affected parties prior to blocking the access.

Whenever any street or highway or portion thereof is in acceptable condition for travel, it shall be opened to traffic subject to the approval by and at the direction of the Engineer. Such opening shall not be held to be in any way an acceptance of the roadway or any part of it or a waiver of any of the provisions of these specifications and contract.

Unless otherwise provided the Contractor shall bear all expenses of maintaining traffic over the section of road undergoing improvement without direct compensation. The Contractor shall give seventy two (72) hours prior notice to the District when major (phase) changes in traffic flow patterns are planned to be made.

- (B) TRAFFIC CONTROL PLAN (TCP).** The TCP for the project shall meet applicable requirements of the MUTCD and of these specifications, and shall be prepared so that the requirements of Traffic Control Restrictions as specified in the Contract documents are met. The TCP shall indicate the scheduling of construction where appropriate and shall show lane closures, means of channelizing traffic through the work areas, roadway closures and detours when specified in the Contract documents, and all traffic control devices, such as warning signs, barricades, drums, cones, beacons, safety barriers with impact attenuators, including their sizes, locations and arrangements, all as required to perform the traffic control as specified.

When required to submit a TCP for approval, it will be submitted as a shop drawing in accordance with 105.02(B). In the event there is no TCP included in the Contract documents, the Contractor shall prepare and submit for approval a TCP meeting requirements herein, if required by the Contract. Payment for preparation, submittal, revising and re-submittal if necessary, of the TCP will be made as specified in 616(C).

When a TCP is included with the contract documents, the Contractor will not be required to prepare and submit a TCP. If the Contractor wishes to accept the TCP for use on the project, he shall so certify by letter to the Contracting Officer. If the Contractor does not wish to use the TCP in the Contract documents, he may submit for approval, prior to start of construction, his own TCP. All costs for preparation, submission, revising and re-submittal, if necessary, of this TCP will be borne by the Contractor. This Traffic Control Plan (TCP) shall:

- (1) Show in detail the placement of all signs, channelizing devices and crash attenuating devices for each phase of construction. The TCP shall be to the same scale as the contract drawing.
- (2) Contain an itemized summary for each phase of the type and quantity of all traffic control devices which will be needed for that phase.
- (3) Maintain equal or greater traffic flow capacity and lane widths as the suggested TCP.

Prior to Notice to Proceed, the Contractor may submit a conceptual TCP in lieu of a detailed TCP for preliminary approval. However, the detailed TCP shall be submitted and approved by the District prior to beginning the affected work.

**(C) TRAFFIC CONTROLS**

- (1) **GENERAL.** All work dealing with traffic control shall be accomplished in accordance with these specifications, the approved TCP, and with the requirements of Part VI of the MUTCD.

All work shall be performed within times as specified in 104.02(A). The Contractor shall not work at nights, on weekends or holidays unless otherwise specified in the Contract documents or approved by the Engineer. Normal traffic flow shall be maintained during these times unless otherwise specified. The time required to implement and remove closures and install and remove traffic control devices shall be included within stated work times.

The Contractor shall coordinate his maintenance of traffic work with other contractors and utility companies working in the same general area to maintain continuity of traffic flow and minimize congestion.

Where directed, vehicular access to abutting properties shall be maintained. The Contractor shall furnish, place, maintain and remove when no longer required all materials, such as AC and/or soil materials, for temporary driveway and alley entrances, where shown in the Contract documents or where directed.

- (2) **TRAFFIC SAFETY OFFICER.** For the duration of the project, the Contractor shall provide a traffic safety officer assigned full-time to the project, who shall be responsible for the maintenance of traffic operations. The traffic safety officer shall meet the qualifications as specified in 616.02(B) (1).
- (3) **PEDESTRIAN CONTROL.** The Contractor shall maintain the proper and safe flow of pedestrian traffic within and adjacent to the project area at all times. Access to abutting properties for pedestrians shall be maintained. The Contractor shall furnish, install, maintain and remove when no longer required the proper traffic control devices, including warning signs, to detour pedestrians when closing sidewalk to pedestrian traffic, where shown in the Contract documents or where directed. The Contractor shall furnish, place, maintain and remove when no longer required all materials for temporary pedestrian walkways, where shown in the Contract documents or where directed.
- (4) **LANE CLOSURES.** When closing a lane to traffic, the Contractor shall furnish, install, maintain and remove when no longer required the necessary signs, channelizing devices such as traffic drums, Type II barricades or cones, and arrow boards, to effect lane closures and to separate lanes of traffic moving in opposite directions through the work area, as outlined in the TCP, Part VI of the MUTCD and these specifications.

Where shown in the Contract documents or where directed, the Contractor shall remove existing lane markings and shall install temporary lane markings, meeting requirements of 616.13 or 616.14, to delineate the temporary lanes as required. Temporary lane markings shall be covered over or removed when no longer required.

The Contractor shall furnish, place and relocate as required portable PCC safety barriers, meeting requirements of 614.02, to prevent the intrusion of errant vehicles into any excavated area deeper than 6 inches. Except when necessary to provide vehicular ingress and egress for the work area, open spaces between adjacent barrier sections shall not be permitted. The Contractor shall furnish and place at all approach ends of the PCC barriers, or at any other roadway obstruction caused by construction, suitable impact attenuators as approved by the Engineer. After the PCC or AC base has been placed in the excavated area or if the area is plated over, the Contractor shall remove the PCC barriers and impact attenuators.

During surfacing or resurfacing operations, PCC barriers shall not be used to protect the work area. Traffic shall be directed past the work area with traffic drums, cones or Type II barricades.

When specified in the Contract documents or when directed, the Contractor shall furnish, install, maintain and remove when no longer required lights, meeting requirements of 616.08, for placement with advance warning signs and upon barriers, drums and/or barricades.

When specified in the Contract documents or when directed, the Contractor shall provide flaggers, meeting requirements of 616.02(B)(2), to safely and expeditiously guide traffic through the work area.

The Contractor shall be required to replace all damaged traffic control devices. Traffic control devices damaged for any reason whatever shall be removed and repaired or replaced by the Contractor at no additional cost to the District.

- (5) **ROADWAY CLOSURES.** When specified in the Contract documents, the Contractor shall furnish, place and remove when no longer required Type III PVC barricades for placement at each end of the length of roadway to be closed and the necessary signs to effect the proper detours around the closed length of roadway.
- (6) **PAVEMENT MARKINGS.** On those roadways where temporary pavement markings are to be replaced with permanent markings, the Contractor shall not remove the temporary markings unless permanent markings can be placed within 24 hours. At no time shall a roadway be without pavement markings, either temporary or permanent.

#### **104.03 VALUE ENGINEERING PROPOSALS BY CONTRACTOR**

- (A) **GENERAL.** This subsection will apply only when it is specifically included or designated in the contract documents. This provision describes the requirements for Value Engineering Change Proposals (VECPs) which are initiated and developed by the Contractor to change the Contract Drawings and Specifications, or other requirements of a contract for the purpose of reducing the total cost of construction without reducing design capacity or quality of the finished product.

A VECP identical to one submitted under one contract, by the same or any other contractor, may also be submitted under a subsequent contract.

- (B) **VECP REQUIREMENTS.** In order to be considered as a VECP, the Contractor at the time of submission to the Engineer, must identify the submission as a Value Engineering Proposal. The VECP must require a change to the contract, must decrease the contract price, and must maintain the finished product's required function such as service life, reliability, economy of operation, ease of maintenance, necessary standardized features and appearance, and not require an extension of contract time.

A VECP submission shall be of sufficient detail to clearly define the proposed change, including:

1. A description of the difference between the existing and the proposed contract requirements, and the comparative advantages and disadvantages of each;
2. Contract requirements recommended to be changed if the proposal is accepted;
3. A detailed estimate of the amount of the net savings, as defined in (E) herein, that will result from acceptance of the proposal;

4. A prediction of any effects the proposed change would have on the cost of maintenance and operation; and
5. A statement of the time by which the proposal must be accepted so as to obtain the maximum price reduction, noting any effect upon the contract time.

The following shall not be considered to be a VECP, but rather a change requested by the Contractor which will result in a reduction in the contract price by the full amount of the gross savings, including the Contractor's labor, material, equipment, overhead, profit and bond:

1. Changes resulting from a waiver of specification requirements.
  2. Changes resulting from unavailability of specified materials.
  3. Changes requested by the Contracting Officer.
  4. Changes based solely on a change in deliverable end item quantities.
- (C) **VECP SUBMISSION WITHDRAWAL.** The Contractor has the right to withdraw part or all of any VECP at any time prior to acceptance by the Contracting Officer. Such withdrawal shall be made in writing to the Engineer. Each VECP submitted by the Contractor shall remain valid for a period of 60 days from date submitted. If the Contractor desires to withdraw the proposal prior to the expiration of this period, he may be liable for the cost incurred by the Engineer in reviewing the proposal.
- (D) **VECP ACCEPTANCE OR REJECTION.** The Contracting Officer may accept or reject part or all of any VECP by giving the Contractor written notice thereof. Until such notice is issued, the Contractor shall remain obligated to perform in accordance with the terms of the contract. VECP'S will be processed expeditiously. However, the Contracting Officer shall not be liable for any delay in acting upon any proposal submitted pursuant to this section. The decision of the Contracting Officer as to acceptance of any such proposal shall be final and shall not be subject to GENERAL PROVISIONS, ARTICLE 7, DISPUTES.
- (E) **CONTRACT ADJUSTMENTS AND PAYMENTS.** When a VECP submission is accepted:
- (1) An adequate adjustment of the contract price and in any other affected provisions of the Contract shall be made and the contract modified in accordance with this section and GENERAL PROVISIONS, ARTICLE 3, CHANGES, or other applicable provision of the contract.
  - (2) The net savings resulting from the change shall be shared equally between the Contractor and the District. The Contractor's share will be paid as part of the next Partial Payment Estimate following the signed approval of a change order by the Contracting Officer in proportion to the amount of work completed under the VECP.
  - (3) Net savings shall be determined by deducting from the estimated gross savings, the Contractor's cost of developing and implementing the proposal and the estimated amount of increased costs to the District resulting from the change, such as implementation, inspection, increases in related items and District furnished equipment or property. Estimated gross saving shall include Contractor's labor, material, equipment, overhead and profit. Anticipated price adjustments for increases in the cost of fuel or material shall not be included as part of the estimated

gross savings. The contract price shall be reduced by the sum of the District's costs and share of the net savings.

- (4) The Contractor is entitled to share in instant contract savings only to the full extent provided for in this section. For purposes of sharing under (E)(1) above, the item "Instant Contract" shall not include any change orders or other modifications to this contract executed subsequent to acceptance of the particular VECP, by which the Contracting Officer increases the quantity of any item or adds any item.
- (F) **RESTRICTIONS ON USE.** The Contractor may restrict the District's right to use any VECP data by marking it with the following statement:

"The data, furnished pursuant to the Value Engineering section of the contract, shall not be duplicated, used nor disclosed, in whole or in part, for any purpose except to evaluate the VECP, unless the proposal is accepted by the Contracting Officer. This restriction does not limit the District's right to use information contained in this data if it is or has been obtained, or is otherwise available from the Contractor, or from another source, without limitations. When this proposal is accepted by the Contracting Officer, the District shall have the right to duplicate, use, and disclose any data in any matter and for any purpose whatsoever, and have others do so whether under this or any other District Contract."

## 105 CONTROL OF WORK

### 105.01 CHIEF ENGINEER'S AUTHORITY

The Chief Engineer will have the authority for administration and engineering supervision of the contract.

The Chief Engineer will decide any question as to interpretation of the Contract including quality and acceptability of furnished materials, work performed, rate of progress and acceptable contract fulfillment. The Chief Engineer has authority to suspend work wholly or in part due to the Contractor's failure to correct conditions unsafe for workmen or the general public; for failure to carry out contract provisions; for such periods needed due to unsuitable weather; for conditions deemed unsuitable for prosecution of the work; or for any condition in the public interest. The Chief Engineer has authority to reject any piece of equipment, staging, formwork or other appliance considered unsafe, improper, or inadequate; whether or not the Chief Engineer exercises this authority, the Contractor is not relieved of his responsibility for safe and proper execution of the Contract.

The Chief Engineer will determine the quantity of each item of work performed and materials furnished, and such decision and estimate for partial payment shall be final and conclusive; such estimate shall be a condition precedent to the Contractor's right to receive any money due under the Contract. In the event of disagreement with the Chief Engineer's decision, the Contractor will have the right to present the matter in dispute to the Contracting Officer for decision pursuant to contract provisions.

The Chief Engineer has the authority to require the Contractor to replace any Contractor's representative, including staff, who is not performing to the satisfaction of the Chief Engineer.

### 105.02 PLANS AND WORKING DRAWINGS

- (A) **REPRODUCIBLE PLANS.** Upon request from the Contractor, the District will furnish free of cost for the Contractor's use, one set of full size reproducible project plans printed from official plans, or an electronic version (CADD file or PDF file).
- (B) **SHOP AND WORKING DRAWINGS.** Shop and working drawings, when required, shall be prepared by the Contractor and submitted to the Chief Engineer sufficiently ahead of proposed work so that review, correction and approval actions as described will not delay construction operations.

Selected shop and working drawings, materials certifications, laboratory test reports, and other required submittals will be subject to review by the design Consultant. Prior to submittal of shop drawings, the Contractor will be informed which submittals shall be transmitted directly to the Consultant's office. Every effort will be made to respond to these submittals within twenty-one (21) working days of the receipt of submittal by the Consultant. All other submittals shall be transmitted to the DDOT office responsible for their approval. The Contractor shall transmit three (3) copies and one (1) reproducible copy of the selected submittals to the Consultant office designated by the District.

- (1) **GENERAL.** Shop drawings shall be drawn in ink on a good grade tracing vellum or, in lieu of ink drawings, satisfactorily photo reproduced from pencil drawings on a tracing vellum or plastic. Drawings shall be prepared on 22 inch by 36 inch sheets and dated. One set of inked vellums or photo-reproduced vellums of all approved shop drawings shall be delivered to the Chief Engineer at the completion of the project.

Working drawings shall be drawn or printed on a material from which clean reproducible copies may be obtained; vellums will not be required.

Working drawings, catalog cuts, performance data and other needed information, for those features that require selection by the Contractor, shall show in detail or by written description the proposed methods and data in sufficient detail so that strengths and sufficiencies can be checked.

The Contractor shall not use any shop or working drawing which does not bear the authorized approval stamp. No work for which shop and working drawings are required shall be started until drawings have authorized approval.

Approval of shop and working drawing by the District shall not relieve the Contractor of his responsibility to furnish all materials and perform all work required by the Contract.

The District is not responsible for discrepancies, errors and omissions on drawings furnished by the Contractor, even though drawings containing discrepancies, errors and omissions were approved.

No change shall be made to approved shop and working drawings without resubmission. Any change so made shall be clearly marked and dated.

- (2) **SUBMISSION PROCEDURE.** The Contractor shall submit to the Engineer one dated copy plus one dated reproducible copy of shop drawings for reinforcing steel, structural steel, Class A stone masonry, railing, electrical work, guardrail, permanent sheeting, temporary structures and other design details as determined by the Department; and one dated copy plus one dated reproducible copy of working drawings for formwork and false work, bracing, bridging, scaffolding and other construction details as determined by the Engineer.

Two (2) copies of working drawings also are required for sheeting, shoring, PCC forms for structures, staging, cofferdams and underpinning; and shall be prepared under the direction and bear the seal of a Registered Professional Engineer; these drawings shall be accompanied by calculations for all stress-carrying members.

The Contractor shall submit 6 dated copies plus 1 dated reproducible copy of shop and working drawings for sewer and water main work showing details for pipe layouts, joints and harnessing, fittings, valves, pile thrust block layouts, pipe reinforcement, and other manufactured equipment and materials. Design data and computations shall be included when requested. For pressure conduits and rubber gasket jointed pipe, a check list shall be submitted showing sequence of submission of anticipated drawings, geometry sheets, bills of material, and laying schedules. Each item shall be tabulated by number, title, sheet or other means of positive identification.

Every effort will be made to return the reproducible copy to the Contractor for any correction required to secure approval within 21 consecutive calendar days after receipt.

The Contractor shall resubmit 1 corrected and dated copy plus 1 corrected and dated reproducible copy of drawings, other than sewer and water main drawings, until approved.

The Contractor shall resubmit 6 corrected and dated copies plus 1 corrected and dated reproducible copy of sewer and water main drawing until approved.

Following approval, the approved reproducible copy will be sent to the Contractor who shall make distribution as specified:

1 copy of shop drawings to Chief Engineer.

3 copies of shop and working drawings to the Chief Engineer.

6 copies of sewer and water drawings to the Chief Engineer.

No measure or payment will be made for shop and working drawings. Cost shall be reflected and distributed in applicable pay items.

### **105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS**

All work performed and all materials furnished shall be in conformity with the lines, grades, cross sections, dimensions, material and construction requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the Chief Engineer finds the materials furnished, work performed, or the finished product not in conformity with the Contract documents, but that reasonably acceptable work has been produced, the Chief Engineer shall then make a determination as to whether the work shall be accepted and remain in place. In this event, the Chief Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials necessary to conform to his determination. Any action taken pursuant to this paragraph may not result in an increase of the contract price.

In the event the Chief Engineer finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the contract documents and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

### **105.04 COORDINATION OF PLANS AND SPECIFICATIONS**

The Contractor shall take no advantage of any error or omission in the plans or of any discrepancy between the plans and specifications, supplemental specifications or special provisions, and the Chief Engineer shall make such corrections and interpretations as may be deemed necessary for the satisfactory completion of the work.

On all plans, the calculated dimensions will govern in case of discrepancy over the scaled dimensions.

**105.05 COOPERATION WITH UTILITY RELOCATION**

The Department will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

Before commencing excavation or demolition work the Contractor shall notify affected parties in conformance with 107.16.

The Department of Transportation's records on locations of utility lines are on file in the Public Space Permits and Records Division . These files are available for the Contractor's use. However, such use shall not be the basis of any claim against the District.

Utility work will be performed by utility owners at no cost to the Contractor except for utility work included as part of the Contract. Vault adjustments will be made by vault owners. It is anticipated that utility or vault work to be performed by others will not interfere with work under the contract; however, should work by others become necessary during the life of the contract, the Contractor shall cooperate accordingly.

For any underground utility or vault encountered, the Contractor shall immediately notify the Engineer and take necessary measures to protect the utility or vault and to maintain its service until relocation by the owner is accomplished.

**105.06 FIELD LAYOUT**

(A) **GENERAL.** The Chief Engineer will furnish all lines, grades and measurements necessary for grading and paving projects. The Chief Engineer will furnish only the baseline and bench marks for bridge and other structure projects including associated paving work. The Contractor shall perform all remaining engineering layout in an approved manner. Layout for bridge and other structure projects shall be performed by competent surveyors under the direction of a Registered Professional Engineer.

The Contractor shall perform all layout for landscape work except for street line trees which will be located by the Urban Forestry Administration..

Work shall be performed only within authorized lines and grades; operations outside authorized areas will not be included for measure and payment.

Stakes or marks the Chief Engineer sets for guidance shall be preserved by the Contractor. If, in the opinion of the Chief Engineer, stakes are displaced, removed or lost due to Contractor's negligence, they will be replaced by the Chief Engineer and charged the Contractor at \$20.00 per stake.

(B) **MATCH OLD WORK.** The Contractor assumes full responsibility for successfully carrying out the complete construction and the fitting of all members. Dimensions shown on the drawings taken from original design and shop drawings are not guaranteed. Where new work is to be fitted to old work, the Contractor shall be responsible for checking all dimensions and conditions in the field. If the parts do not fit properly, the Contractor shall make alterations to the new parts necessary to assure proper fit and connection in accordance with instructions of the Chief Engineer, at no additional expense to the District.

Prior to preparing his bid, the Contractor shall visit the worksite and carefully examine the condition of the various parts of the structure and then include in his bid, costs for making measurements necessary or convenient for the proper completion of the work.

#### **105.07 INSPECTOR'S AUTHORITY**

Inspectors designated as representatives of the Department of Transportation, including private consultants, shall have authority to inspect all work and furnished materials. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the material to be used. In case of dispute between the Contractor and Inspector, the Inspector has authority to reject work and materials and to suspend work until the Chief Engineer is able to resolve the case. Inspectors have no authority to alter, waive or add to contract requirements, nor to approve or accept any portion of the work.

#### **105.08 LOAD RESTRICTIONS**

The Contractor shall comply with all legal load restrictions in the hauling of materials on the streets and bridges beyond the limits of the project. A special permit will not relieve the Contractor of liability for damage which may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures, or appurtenances will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed by the Chief Engineer to prevent damage to any portion of the pavement structure or underlying utilities. No loads will be permitted on a concrete pavement, base or structure before the expiration of the curing period. In no case shall legal load limits be exceeded unless permitted in writing. The Contractor shall be responsible for all damage done by hauling equipment.

#### **105.09 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE**

If the Contractor, at any time, fails to maintain the site properly in conformance with the terms of the contract documents, the Chief Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to commence repair, beyond mobilization, of the unsatisfactory maintenance within four (4) hours of receipt of such notice, the Chief Engineer may immediately proceed to maintain the project, and the entire cost of the maintenance will be deducted from monies due or to become due to the Contractor.

#### **105.10 WEEKEND WORK**

No work shall be permitted on Saturdays or Sundays without prior written approval of the Chief Engineer, his designee or as otherwise specified in the contract.

#### **105.11 NIGHT WORK**

(A) **GENERAL** -The Contractor shall work at night when it is specified or when, in the judgment of the Contracting Officer, such action is necessary. to maintain illumination levels for safe operations in all active work areas during evening and night work. Temporary lighting for the Contractor's operations shall comply with OSHA regulations, Section 1926, task requirements and as specified in contract documents.

The Contractor shall be subjected to area noise ordinances for night work from 7 P.M. to 7 A.M. and to the restrictions on equipment as indicated below except as permitted by a variance. The Department will support the Contractor’s efforts in applying for a variance that will permit reasonable day and nighttime noise limits. However, the Department gives no guarantee concerning the noise levels granted in any waiver, nor whether or not the variance is granted.

**D.C. MAXIMUM PERMITTED NOISE LEVEL**

(as defined in D.C. Law2-53, District of Columbia Noise Control Act of 1977)

Zone	Maximum Noise Level (dBA)	
	Daytime	Nighttime
<i>Residential, Special Purpose Or Waterfront Zone</i>	55	60
<i>Commercial or Light Manufacturing Zone</i>	60	65
<i>Industrial Zone</i>	70	65

- (B) **RESTRICTIONS** – The use of all mechanical impact demolition equipment will be absolutely prohibited between the hours of 10:00 P.M. and 7:00 A.M.
- (C) **MEASURE AND PAYMENT** – No separate measure or additional payment will be made for Night Work or Night Lighting.

**105.12 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK AND MATERIALS**

No work shall be performed or materials ordered or furnished for the project without supervision or inspection by a representative of the Department.

Work done prior to Notice to Proceed, work beyond project limits intended by plans or as directed, work done during a work suspension, work deviating from requirements without written authority, extra work done without authority or work done contrary to the Chief Engineer’s instructions will be considered unauthorized. The District is not obligated to pay for unauthorized work. Unauthorized work and materials may be ordered removed and replaced as directed at Contractor expense.

**105.13 INSPECTION – ACCEPTANCE**

- (A) **GENERAL.** Any work or materials determined to be unacceptable under 105.12 may be ordered removed and replaced at Contractor expense. Failure to inspect or reject work or material shall not in any way imply acceptance, nor prevent the District from later rejecting the work.

Costs associated with inspection services will not be permitted in claims nor as a basis of claims.

When a unit of government other than the District, or a railroad has an interest in or is affected by the Contract, its respective representatives shall have the right to inspect the portion of the work affecting its interests. Such inspection shall not make any government

unit or railroad a party to the Contract nor interfere with the rights of the District or the Contractor.

- (B) **PARTIAL ACCEPTANCE.** When the Contractor completes a suitable unit or portion of the project, the Engineer may make, or the Contractor may request, final inspection of that unit. If the Chief Engineer finds the unit complete and meets contract requirements, he may accept in writing that unit as complete which written acceptance shall include a description of specific work accepted, and the Contractor may be relieved of further responsibility for the accepted unit. Such partial acceptance shall not void nor alter any contract provision.
- (C) **FINAL INSPECTION AND ACCEPTANCE.** Within 30 consecutive calendar days after receipt of written notice from the Contractor that contract work is complete and the project area cleaned up, the Chief Engineer will make final inspection of the project. The Contractor shall promptly correct any deficiency as determined, and upon acceptable completion of all work and cleanup the Chief Engineer will certify in writing as to completion and the amount and value of each class of completed work for purposes of final payment. All prior certificates or estimates upon which partial payments may have been made will be subject to correction in the final payment.

The project will not be accepted until the Contractor has met all contract requirements.

## 106 CONTROL OF MATERIALS

### 106.01 SOURCE OF SUPPLY AND QUALITY

Only materials meeting the requirements of these specifications and approved by the Chief Engineer shall be used. Materials may be subjected to inspection or test at any time during their preparation for use.

The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Chief Engineer of his proposed sources of materials prior to delivery. At the option of the Chief Engineer, materials may be approved at the source of supply before delivery is started. If it is found that sources of supply for previously approved materials do not produce specified products, the material and/or source of supply may be rejected.

The entire output of any source of supply may be rejected when a continuous supply of satisfactory material cannot be obtained.

Unless specifically approved by the Chief Engineer, material sources shall not be changed in the course of a project.

Approval of a material for a particular purpose, use, or project in a specified manner does not constitute approval for its use for any other purpose, project or manner.

Materials which appear defective upon arrival shall not be used until approved. All rejected materials shall be promptly removed from the site.

### 106.02 SAMPLES, TESTS AND CITED SPECIFICATIONS

All materials shall be inspected, tested and accepted by the Chief Engineer before incorporation in the work. Any work in which untested or unaccepted materials are used will be performed at the Contractor's risk and may be considered as unacceptable and unauthorized work.

The Contractor, when directed by the Chief Engineer, shall furnish material samples for inspection or testing. These samples may be required prior to or during the use of the material or at any time prior to acceptance of the work. Unless otherwise designated, materials shall be sampled and tested in accordance with the requirements of the standards which are current on the date of advertisement for bids.

Samples shall be taken in accordance with the following:

1. Samples of untreated aggregates or soils shall be taken from the road at the laydown machine prior to compaction.
2. Samples of bituminous mixtures shall be taken from the road at the lay down machine and/or from the plant out of the truck; for the determination of gradation, bituminous content, and other properties as specified. In addition, the Contractor shall furnish test samples cut from the compacted mixtures (2 per city block) at locations designated by the Chief Engineer. The Contractor shall repair the areas from which the samples were cut at no additional cost to the District.

3. Samples of portland cement concrete shall be taken from the hauling unit at the project site for the determination of slump and air content, unit weight and for the fabrication of test beams and cylinders.
4. Samples of cement-treated and lime-treated materials shall be taken from the road at the laydown machine prior to compaction for the determination of gradation, moisture content, unit weight and the fabrication of test cylinders.
5. Tests for density shall be made after the compaction process has been completed.
6. Thickness determinations of pavement layers shall be made on the road, by coring or test pitting, after all compacting and processing has been completed.
7. Manufactured materials such as portland cement, steel, hydrated lime, bituminous materials, paint, materials used in signs, lighting and traffic signals may be sampled at the producer's plant. Before final acceptance, such materials shall be subject to inspection and further testing after delivery to the project as determined by the Chief Engineer. Project samples shall be taken before the material is incorporated into any other product.

Where sampling and testing of a material prior to use is required by the Chief Engineer, the Contractor shall provide the necessary samples sufficiently in advance of contemplated use for testing and approval. Samples shall be delivered to the location as determined by the Chief Engineer. Material samples shall be submitted with the appropriate project name, source of material, and intended use of material.

When samples are taken at the job site by the Department's personnel or by any personnel of a materials testing firm employed by the Department to obtain such samples for testing, the Contractor shall provide sufficient personnel of his employment to convey the samples from the sampling location to the vehicle waiting to transport them for testing, and load the samples upon the vehicle for shipment to the testing laboratory. All costs to the Contractor for assisting in this effort shall be absorbed as part of the payment made for the item for which the material is being furnished.

Table 106.02 gives the minimum sampling requirements for materials for test.

Longer times required to test materials does not waive any specification requirements for the material or work.

New materials sources or non standard materials are job dependent.

**TABLE 106.02 MINIMUM SAMPLING REQUIREMENTS FOR MATERIALS**

MATERIAL	MINIMUM SAMPLE REQUIRED	WORKING DAYS TO OBTAIN VERBAL TEST RESULTS
Admixtures (Portland Cement Concrete)	See 814	
Aggregate, Coarse (PCC & Asphalt)	70 pounds	5
Aggregate, Fine		
Bituminous	20 pounds	5
Blanket	10 pounds	
Concrete	20 pounds	
Filter	10 pounds	
Mortar	10 pounds	
Vertical	10 pounds	
Aggregate, Source (new)	200 pounds	60
Anchor Bolts	1 specimen per lot	6
Asphalt Cement (complete)	Standard 16 oz. can	5
Asphalt Cores	Job Dependent	1
Asphalt, Cut-Back	1 quart	5
Asphalt, Emulsified	4 quarts	5
Asphalt Primer for Waterproofing	1 quart	5
Asphalt Seal Coat for Waterproofing	1 quart	5
Bituminous Mixtures	12 pounds	12
Job Mix Formulas	75 pounds	21
Brick:		
Building	10 specimens	12
Sewer	10 specimens	12
Burlap	3 foot length x width of roll	4
Caulking Compound	1 pint	20
Canvas	2 square yards	4
Ceramic Tile	25 specimens	40
Concrete Mix Design	6 cubic feet	50
Concrete, Wet (Dunagan)	30 pounds	
Dowel Bars	3 specimens	6
Electrical Items	Job Dependent	
Expansion Joint Filler	3 foot length x width (4-1/2 inch min.)	16
Gravel	70 pounds	
High Tensile Strand (or wire)	5 foot length	11
Load Transfer Devices	1 specimen	6
Masonry Cement	10 pounds	16
Membrane (liquid) Curing Compound	1 quart	6
Mineral Fiber	5 pounds	5
Paint and Coatings (2)	4 – 1 quart cans	30
Pipe:		
Clay	2 specimens	6
Concrete		
Polyethylene Sheeting	2 yards x 10 inches	11

**TABLE 106.02 MINIMUM SAMPLING REQUIREMENTS FOR MATERIALS  
(Continued)**

<b>MATERIAL</b>	<b>MINIMUM SAMPLE REQUIRED</b>	<b>WORKING DAYS TO OBTAIN VERBAL TEST RESULTS</b>
Portland Cement	10 pounds	
Preformed Bearing Pads	4 inch x 4 inch	
Prestressed Reinforcement	Per Section 815.02	
Reinforcing Steel:		
Bar Nos. 2 through 9	1 specimen 5 feet in length	6
Bars larger than No. 9	1 specimen 7 feet in length	6
Saturated Cotton Fabric	4 foot length x width of roll	6
Sealing Compounds:		
Cold Poured, Emulsion	1 quart	16
Cold Poured, Mastic	1 quart	16
Cold Poured, Two-component	1 quart	20
Hot Poured	5 pounds	16
Shear Connector Studs	1 specimen	
Soils:		
Gradation LL and PI	20 pounds	5
Gradation and Proctor	100 pounds	6
Top Soil	20 pounds	11
Subgrade Paper	3 foot length x width of roll	6
Tar (Creosote) Primer for Waterproofing	1 quart	6
Tar, Road	1 quart	6
Tar Seal, Coat for Waterproofing	1 quart	6
Tie rod assemblies	3 specimens	6
Waterproof Paper	2 square yards	11
Waterstop, Rubber	2 square feet	11
Waterstop, PVC	2 square feet	30
Welded Wire Fabric	3 feet x 3 feet	6
Miscellaneous Materials and Tests:		
Determining Thickness of Metals	Representative sample	6
Determining Unit Weight of Metals	Representative sample	6
Determining Thickness of Galvanizing	Representative sample	6
Identification of Wrought Iron Infra Red Spectrum	Representative sample	2

### 106.03 MATERIALS COMPLIANCE CERTIFICATION

The Contractor shall furnish material compliance certifications for all manufactured materials obtained from vendors or producers, prior to their incorporation into the work.

The Contractor shall submit certificates to demonstrate proof of compliance with requirements for products and materials, qualifications of personnel, and results of testing. Each certificate shall be signed by an official authorized to certify on behalf of the issuing organization. Certificates shall show the name and address of the Contractor, the Project identification (Invitation Number, Project Description and Federal-Aid Number(s), if applicable, as shown on the title pages of the Specifications and Bid Proposals) and, if for a material, the quantity and date(s) of shipment to which the certification applies. Certificates shall not be construed as relieving the Contractor from furnishing satisfactory material if in subsequent testing of samples the material does not meet specified requirements. The original and two copies of all certificates shall be submitted unless otherwise specified.

The Contractor shall certify monthly that the portland cement, portland blast furnace slag cement, coarse and fine aggregates, admixtures and water conform to the source, quality and grading as stated on the current approved job mix formulae and the contract documents.

The Chief Engineer may permit use prior to sampling and testing of certain materials or assemblies accompanied by certifications stating that such materials or assemblies fully comply with the requirements of the Contract. The certificate shall be signed by the manufacturer. Each lot or assembly delivered to the work must be accompanied by a certification in which the lot is clearly identified.

Materials used on the basis of certifications may be sampled and tested at any time and if found not to be in conformity with contract requirements will be subject to rejection whether in place or not.

#### **106.04 PLANT INSPECTION**

The Department shall have full access at all times to those parts of materials sources, asphalt and PCC plants, steel fabrication shops and pre-cast facilities as may concern the production and manufacture of materials and products needed for the Contract.

The Contractor shall notify the office of the chief plant inspector 24 hours before concrete or asphalt is to be delivered to the project site. In the event that delivery is suspended for an indefinite period, a 24 hour notice is also required in advance of a resumption of delivery.

#### **106.05 QUALITY CONTROL OF PLANTS**

The Contractor shall assume the responsibility for the quality control and condition of all material during the handling, blending and mixing operations. The Contractor shall assume responsibility for the initial determination and all necessary subsequent adjustments in proportioning of materials used to produce the specified job-mix. The Contractor shall have available the testing equipment necessary to perform stockpile and hot bin analysis (asphalt) or bin samples (PCC) required below.

The Department's Inspector will not assume by act or word the responsibility for mix control adjustments, calculations or the setting of dials, gages, scales and meters. Such duties are to be assumed only by the Contractor. Tests for conformance with the specifications may be made on samples of the materials entering into the composition of the mix, samples of the mixture, and samples cut from the completed pavement. The Contractor shall cooperate with the Chief Engineer in obtaining these samples. When samples are cut from the pavement, the voids caused by the cuts shall be replaced and refinished without additional compensation. The

preparation of all bituminous mixtures and portland cement concrete mixes shall be subject to inspection at the plant. For this purpose, the Contractor shall provide an acceptably furnished and equipped laboratory in accordance with the requirements of 106.06(A).

Generally, the testing of bituminous and Portland cement concrete mixes at the plant is provided by the Department as a routine check upon the adequacy of the Contractor's quality control procedures.

In lieu of an acceptance program involving continuous sampling, testing, and weight verifications at the source, small quantities of material may be accepted by the Chief Engineer based upon continuous or occasional sampling and testing at the source, supplemented by visual examination at point of delivery; and, based upon weights furnished by the Contractor (or supplier) on the weight tickets. The frequency of sampling, testing and weight verification by an Inspector at the source will be established by the Chief Engineer based upon the Department's current acceptance program and local conditions encountered.

#### **106.06 FIELD FACILITIES**

(A) **ASPHALT AND PCC PLANTS.** The Contractor shall furnish and maintain a laboratory wherein approval testing for mixture composition will be performed by the Department at the location(s) approved for plant processing of material at the Contractor's expense. The Contractor may utilize the laboratory and equipment for the purpose of performing quality control testing; however, in the event the dual testing programs overlap in such a manner as to interfere with the check and acceptance tests to be performed by the Department, the Department shall have priority in the use of the facilities and equipment. Only one laboratory will be required by the Department per plant regardless of the number of contracts from which the material is being processed.

The plant laboratory and equipment furnished by the Contractor shall remain the property of the Contractor. Equipment furnished by the Contractor shall be subject to inspection and calibration by the District at anytime during the contract performance period. Test equipment found not to be in calibration and proper working condition shall be adjusted, repaired or replaced immediately to the satisfaction of the Chief Engineer. The space provided for the plant laboratory shall be used for laboratory purposes only. The laboratory shall be erected before the processing of material begins and shall be available throughout the duration of the plant operation. It shall be removed upon completion of the project, if located on the project.

The laboratory shall be of weatherproof construction, tightly floored and roofed, and constructed with an air space above the ceiling for ventilation.

The width of the laboratory shall not be less than 8 feet and the floor-to-ceiling height shall not be less than 6 feet 6 inches. The floor space shall be not less than 160 square feet, with a minimum working area of not less than 140 square feet. The inside walls and ceiling shall be constructed of plywood, masonite, gypsum board, or other suitable materials. Walls and ceiling shall be insulated.

The laboratory shall contain at least 2 windows, each having an area of not less than 540 square inches, can be easily opened and secured from the inside only. The laboratory shall contain at least one door. Both window and door screens shall be provided. The

door(s) shall be equipped with lock(s) and at least 2 keys for each lock shall be furnished to the Chief Engineer.

The laboratory shall have satisfactory lighting, telephone, heating equipment, water supply, exhaust fan, air-conditioner and electrical outlets (120 V and 220 V) and shall be connected to an operational power source.

Heating and air conditioning equipment shall maintain a temperature of not less than 68°F and not more than 78°F.

The capacity of the exhaust fan shall be such that it will exhaust, each hour, a volume of air equal to at least 10 times the cubical volume of the laboratory. Fuel for the heating equipment and electrical current shall be furnished by the Contractor. The Contractor shall also furnish and maintain one chemical type and one 2-1/2 gallon pressurized water fire extinguisher of standard commercial quality.

A suitable indoor toilet connected to a sanitary sewer shall be provided. If a sanitary sewer is not available a suitable outdoor toilet conforming to the requirements of the Board of Health, or other bodies having jurisdiction in the area, shall be provided.

In addition to the general requirements stated herein, the laboratory shall be equipped with the following:

**No. DESCRIPTION**

- 1 Work bench (96 x 30 inches)
- 1 Desk (60 x 34 inches)
- 1 Sink connected to operational water source with approximate dimensions: length 24 inches; front to back 18 inches; depth 8 inches
- 1 Printing electronic calculator
- 1 Metal, 4 drawer file cabinet (15 inch drawer width)
- 2 Chairs
- 1 Waste basket
- 1 Pencil sharpener
- 1 First aid kit
- 1 Potable water supply
- 1 Eye wash station connected to a potable water supply (asphalt laboratory)

The Contractor will furnish the following minimum testing equipment:

- 1 Centrifuge extractor (3,000 grams capacity) or equal
- 2 Electric hot plates thermostatically controlled with 3-way plug and cord
- 1 Triple beam balance with scoop, capacity 2600 grams
- 1 Triple beam balance with scoop, capacity 20 kilograms
- 1 Set of sampling equipment, steel buckets, square nose shovel, sampling thief and sampling bags
- 1 Mechanical sieve shaker for 8 inch diameter sieves, 2 inch through No. 200 mesh
- 1 Set of brass frames, 8 inch diameter sieves, 2 inch through No. 200 mesh
- 1 No. 200 Wet Washing Sieve, brass frame 4" height above mesh
- 1 Sample Splitter with opening to one and one half inches
- 1 Mechanical Shaker, with the following screen tray sizes: 2", 1-1/2", 1", 3/4",

1/2", 3/8", No. 4, No. 8, No. 10, No. 16 and pan; and also, for asphalt plants, the following specified equipment which shall conform to the requirements of AASHTO T 245.

- Concrete thermometers
  - 3 Specimen Mold Assembly
  - 1 Specimen Extractor
  - 1 Compaction Hammer Mechanical Compactor with counter and pedestal
  - 1 Safety can, 2-1/2 gallon capacity
  - 1 Lab Type Oven
  - 2 Dial Type Asphalt Thermometers
- Extraction fluid conforming to AASHTO T 164. Used extraction fluid shall be disposed of by the Contractor in conformance with Federal and City laws.

Miscellaneous supplies; pans, brushes, scoops or large spoons, trowels, graduated beakers and an adequate supply of running water shall be provided. The equipment specified shall be installed ready for operation in a field laboratory conforming to the above requirements.

Adjacent to the platform scales at asphalt plants, the Contractor shall furnish a platform of sufficient height for checking mix temperatures and operations.

- (B) STEEL FABRICATION SHOP.** The Contractor shall make provisions, at his expense, to furnish and maintain at the Steel fabrication shop acceptable office space with adequate light and a telephone for the exclusive use of personnel performing shop inspection for the District.

This office space shall be furnished with the following:

No.	DESCRIPTION
1	Drawing table
1	Metal, 4 drawer file cabinet (15" drawer width)
1	Desk
2	Chairs

- (C) PRECAST FACILITIES.** The Inspector shall have full access at all times to all parts of the yard where units to be inspected are being constructed. The Contractor shall furnish the necessary equipment and facilities for inspection of workmanship and physical tests. The Contractor shall provide for the Inspector a suitable office with all utilities including telephone service.

#### **106.07 STORAGE OF MATERIALS**

Materials shall be stored so as to insure the preservation of their quality and fitness for the work and shall be located so as to facilitate prompt inspection. When considered necessary, they shall be placed on concrete platforms or other hard, clean surfaces and not on the ground, and shall be placed under cover when necessary for proper protection. Materials from different sources of supply shall not be stored in the same stockpile unless approved by the Chief Engineer.

Stockpiles of aggregate shall be built in horizontal layers not to exceed 3 feet in height. Each layer shall be completely in place before the next is started and shall not be of such height as to cause coning or segregation. Aggregates which become mixed or contaminated with soil or other foreign material when in stockpiles shall be rejected. Care must be used in removing the material near the base of the pile.

#### **106.08 HANDLING OF MATERIALS**

Vehicles used in transporting aggregates, portland cement, asphalt, or similar construction materials must be kept clean and free from all foreign matter, be in proper working condition and have strong, substantial bodies which will prevent the escape of materials during transportation. Any material shipped in a conveyance containing foreign material shall be rejected regardless of the quality of said materials as determined otherwise.

Aggregates shall be handled in such a manner as to prevent coning or segregation.

#### **106.09 UNACCEPTABLE MATERIALS**

All materials not conforming to the requirements and specifications shall be considered as unacceptable and will be rejected and be removed immediately from the site of the work. Rejected material shall not be used until the defects have been corrected and approved by the Chief Engineer.

**REFERENCE TESTS.** In the event the Contractor demonstrates that the test results obtained from a sample taken to evaluate a particular lot appear questionable, the Contractor may request in writing that additional tests be taken of that lot. Upon receipt of the written request, additional samples will be randomly selected and an appropriate number of retests made.

If the results of the new tests indicate the material does not conform to the specifications and is not acceptable, the full cost of the test shall be borne by the Contractor.

#### **106.10 MATERIAL SHORTAGES**

The Contractor is advised to anticipate shortages of certain products particularly those containing steel, copper, aluminum, portland cement, and asphalt, and is urged to place orders as early as practicable to provide producers and suppliers with maximum lead time. If timely deliveries still cannot be assured from usual sources, alternative suppliers should be fully considered.

Reasonable time extensions, exclusive of further compensation, for delays due to such products being in short supply, will be granted only if delays are beyond the control of the Contractor, fabricator, or supplier and written evidence of such delays, satisfactory to the Chief Engineer, is submitted concurrently with the delays and not after the fact.

#### **106.11 MATERIALS ORDER**

A completed materials order shall accompany each quantity and shipment of materials from issue point to the job site, and shall be delivered to the Inspector. Each materials order shall consist of an approved form serially numbered; additional information and certification shall be promptly furnished if requested.

A copy of each order shall be retained by the Inspector at material issue point. Payment may not be made for materials not accompanied by a proper materials order.

### **106.12 PROCESSING OF MATERIALS**

All work shall conform to the appropriate provisions of the current Occupational Safety and Health Standards (OSHA). The attention of those contractors furnishing and processing materials in the District is specifically directed to OSHA 29 CFR 1926.58 issued June 1986.

### **106.13 CONTRACTOR PROCESS QUALITY CONTROL AT ASPHALT AND CONCRETE PLANTS**

**SCOPE** – This section establishes minimum requirements and activities for Contractor-based process quality control systems (Process Control). Process control is a series of samples and tests for controlling the delivery, handling, measuring, batching and mixing of construction materials at Asphalt and Concrete Plants. The results of process control tests may be used as a basis to accept or reject a material.

**FUNCTIONS AND RESPONSIBILITIES** – The District of Columbia Department of Transportation (DDOT) will approve mix designs and job mix formulas. DDOT will also provide random plant inspections to monitor and verify control of the operations to assure conformity of materials with the Contractual Specifications.

At no time will the DDOT representative issue instructions to the Contractor or their producer as to setting of dials, gauges, scales and meters. However, DDOT representatives may question and warn the Contractor against the continuance of any operation(s) or sequence of operations which may result in unsatisfactory compliance with specification requirements.

The Contractor shall submit in writing their proposed quality control plan to DDOT prior to the pre-construction conference for review and approval. The plan should contain the sampling, testing, inspection, and frequencies to maintain process quality control. Minimum testing, and inspection activities are shown in Table 106.13A and 106.13B.

The activities shown in Tables 106.13A and 106.13B are minimum activities necessary to control production at an acceptable quality level. It is recognized, however, that depending on the type of process or materials, some of the activities listed may not be necessary and in other cases, additional activities may be required. The frequency of these activities will also vary with the process and the materials. The frequency of these activities, when there are deficiencies in the quality of the materials processed, will be increased until the proper conditions have been restored.

The Contractor shall provide and keep up-to-date control charts/computer data bases (as approved by the Contractor's QA/QC Plan) for all quality control sampling and testing.

The Contractor shall be responsible for the formulation of all mix designs. In accordance with D.C. Standard Specifications 817 and 818, the Contractor's proposed mix designs must be submitted to DDOT for approval, thirty-five (35) calendar days prior to their use. The Contractor shall be responsible for the process control of all materials during handling, blending, mixing, and the placing operations.

**TABLE 106.13A**  
**MINIMUM CONTRACTOR PROCESS QUALITY CONTROL REQUIREMENTS**  
**FOR BITUMINOUS MATERIALS**

- A. All Types of Plants
  - 1. Stockpiles
    - a. Determine gradation of all incoming aggregates as per AASHTO T-27 (Weekly or as directed by the Chief Engineer)
    - b. Inspect stockpiles for separation, contamination, segregation, etc. (Daily)
  - 2. Cold Bins
    - a. Observe operation of cold feed for uniformity (Daily)
  - 3. Bituminous Mixture
    - a. Determine percent bitumen as per AASHTO T-308 (per 500 tons)
    - b. Determine mix gradient per AASHTO T-30 (per 500 tons)
    - c. Determine mix percent air voids as per AASHTO T-269 (per 500 tons)
    - d. Produce and test Gyratory samples as per AASHTO TP4 (per 500 tons)
    - e. Check mix temperatures (Hourly)
    - f. Maintain file of incoming asphalt binders (asphalt cement) certifications.
    - g. Determine asphalt dust ratio as per DDOT Specifications
    - h. Maintain log of various asphalt binders in storage tanks.
  - 4. Completion of Shipping Tickets shall include the following information:
    - a. Name of Asphalt supplier.
    - b. Ticket serial number.
    - c. Quality control person's certification of performance for each mix type and each Contract number (with first load).
    - d. Date, truck and load number.
    - e. Name of Contractor.
    - f. D.C. Contract number and location of placement.
    - g. DDOT approved job mix formula and asphalt class.
    - h. Temperature of mix loaded on truck.
    - i. Certified truck weight and total volume weight of asphalt shipped.
    - j. Release agent for truck beds.
- B. Batch Plants
  - 1. Check mixing times.
  - 2. Check operations of weight bucket and scales.
- C. Drum Mixer Plants
  - 1. Determine gate calibration chart for each bin.
  - 2. Determine gate settings for each bin to assure compliance with DDOT approved job mix formula.
  - 3. Determine gallons per revolution or gallons per minute to assure compliance with DDOT approved job mix formula.
  - 4. Determine moisture content of stockpiles.

**TABLE 106.13B**  
**MINIMUM CONTRACTOR PROCESS QUALITY CONTROL REQUIREMENTS**  
**FOR PORTLAND CEMENT CONCRETE (PCC)**

- A. Incoming Materials
  - 1. Maintain file of incoming Portland cement and admixture shipment certifications.
  - 2. Check proper Portland cement storage.
  - 3. Determine gradation of incoming aggregates and fineness modulus of fine aggregate as per ASTM C-136 (Daily).
  - 4. Certify that all incorporated materials are from approved sources.
  - 5. Maintain stockpiles to prevent separation, contamination, segregation, frozen aggregates, etc. (Daily).
- B. Measuring Devices
  - 1. Check that scales are calibrated/checked for accuracy and precision (Daily).
  - 2. Check that flow meters are calibrated/checked (Daily).
  - 3. Moisture meter checked/verified by ASTM C-566 method moisture testing (Daily).
  - 4. Check admixture dispensers calibrated and functioning (Daily).
  - 5. Check Plant clock for accuracy (Daily).
- C. Mixers
  - 1. Manufacturer's design details on-hand.
  - 2. Check that the central mixer-timing device is certified and properly functioning (Daily)
  - 3. Check that truck mixer-timing device is certified and is properly operating.
  - 4. Check water gauges, etc. (Daily).
  - 5. Check that mixes are free of hardened concrete (Twice annually).
  - 6. Inspect mixers for proper functioning, wear, hardened concrete, etc. (Twice annually).
- D. Mixing Concrete
  - 1. Check for proper batching sequence (Daily)
  - 2. Check for proper mixing speed and time (Daily)
  - 3. Check concrete for uniformity, tested for specification compliance (Twice daily) (Slump as per ASTM C-143; Air Content as per ASTM C-172,C-173 and C-231; unit weight as per ASTM C-138)
  - 4. Mixture Adjustment- adjustment for moisture correction every four hours.
- E. Completion of Batch Tickets  
 Include the following information:
  - 1. Name of Concrete supplier
  - 2. Ticket serial number, date, D.C. Contract number, and truck number.
  - 3. Name of Contractor
  - 4. Quality control person's certification of performance for each mix type and Contract number (for first load).
  - 5. Location of placement.
  - 6. DDOT mix design approval number and concrete class.
  - 7. Component quantities and concrete total volume.
  - 8. Moisture correction for aggregate moisture, and total water in mix.
  - 9. Time of batching.
  - 10. Maximum amount of water that may be added to the mix at the project site.

**QUALITY CONTROL SYSTEM**

1. **General Requirements.** The Contractor shall furnish and maintain a quality control system that will provide reasonable assurance that all materials and products submitted to DDOT for acceptance conform to the Contract requirements, whether manufactured or processed by the Contractor or procured by the Contractor from suppliers or subcontractors. The Contractor shall have performed the inspection and tests required to substantiate product conformance to contract requirements by a DDOT certified materials testing laboratory. The Contractor shall have a qualified quality control technician, who has been certified by DDOT at an asphalt or concrete plant where materials are being produced for DDOT. DDOT certification is dependent upon a Mid-Atlantic State's certification and on-the-job performance evaluated through the DDOT Independent Assurance Test Program and random inspections conducted by DDOT staff. The Contractor's quality control procedures, inspection, and test results shall be documented and available for review by DDOT throughout the life of the contract. Upon completion of the project, the Contractor shall submit these items to DDOT.
2. **Documentation.** The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of tests made, the number of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken. The Contractor's documentation procedures will be subject to the review and approval of DDOT prior to start of the work and to compliance checks during the progress of the work. All charts and records documenting the Contractor's quality control tests and inspections shall become the property of DDOT upon completion of the work.
3. **Charts and Forms.** All conforming and nonconforming inspections and test results shall be recorded on approved forms and charts, which shall be kept up-to-date and complete, and shall be available at all times to DDOT assuring the performance of the work. Test properties for various materials and mixtures shall be charted on forms that are in accordance with applicable requirements of DDOT. A copy of each chart and form to be used by the Contractor shall be furnished to DDOT. DDOT will design and provide standardized test report forms and material control charts in an electronic format. The Plant Laboratory shall utilize the forms and charts as designed for their reporting purposes.
4. **Corrective Actions.** The Contractor shall take prompt action to correct any errors, equipment malfunctions, process changes, or other assignable causes, which have resulted in or could result in the submission of non-compliant materials or products. When it becomes evident to DDOT that a Contractor is not controlling its process and is making no effort to take corrective actions, DDOT will require that operations be ceased until such time as the Contractor can demonstrate that it can and will control the process. Should it become evident that a fraudulent claim has been made as to the quality of the material(s) utilized or produced, or a similarly fraudulent claim is made to the calibration of equipment, the DDOT Chief Engineer may de-certify the Plant operation for a period of thirty (30) calendar days, or as otherwise determined by the DDOT Chief Engineer. Additional fines, penalties or damages

may be assessed as determined by the Chief Engineer and authorized by law, regulation or contract terms.

5. **Asphalt and Concrete Laboratories with Measuring and Testing Equipment.** The Contractor shall ensure that the Plant's testing laboratory is equipped with all the necessary equipment and supplies for proper process control sampling, testing, record keeping and test reporting purposes. To assure accuracy, the testing equipment shall be checked prior to startup and periodically as directed by DDOT in accordance with applicable standards.
6. **Sampling and Testing.** Sampling testing methods and procedures used by the Contractor to determine quality conformance of the materials and products will be the same as those used by DDOT (See Tables 106.13 A and 106.13B). The Contractor's quality control plan will include the taking of samples on a random basis as approved in Quality Assurance Control Plan and the plotting of test results on control charts and/or computer data files.
7. **Alternative Procedures.** The Contractor may use alternative sampling methods, procedures, and inspection equipment when such procedures provide, at a minimum, the quality assurance required by the contract documents. Prior to applying such alternative procedures, the Contractor shall describe them in written proposal and shall demonstrate for the approval of DDOT that their effectiveness is equal to, or better than, the contract requirements. In case of dispute as to whether certain procedures proposed by the Contractor may be used, the contract documents shall apply. Where contract documents are silent on the matters in question, it is left to the final determination of the Chief Engineer.
8. **DDOT Inspection at Subcontractor or Suppliers Facilities.** DDOT reserves the right to inspect materials not manufactured within the Contractor's facility. This inspection shall not constitute acceptance nor shall it in any way replace the Contractor's inspection or otherwise relieve the Contractor of their responsibility to furnish an acceptance material or product. When inspection of the subcontractor's product is performed by DDOT, such inspection shall not be used by the Contractor as evidence of effective inspection of such subcontractor's or supplier product. The Contractor, as necessary to assure conformance with contract requirements, shall inspect subcontracted or purchased materials when received. The Contractor shall report to DDOT any nonconformance found on DDOT source inspection material and shall require the supplier to take necessary corrective action.

#### **106.14 MINIMUM REQUIREMENTS FOR TESTING LABORATORIES AT ASPHALT AND CONCRETE PLANTS**

- (A) **SCOPE** – To have assurance that testing laboratories are capable of achieving an acceptable level of results, it is necessary that certain minimum standards be established. The minimum requirements include criteria for personnel, equipment and quality control procedures. The requirements apply to all construction acceptance testing and inspection including asphalt concrete job mix formulas and portland cement concrete mix designs.
- (B) **REQUIREMENTS** – To achieve approval, the testing laboratory shall meet the current DDOT specifications requirements applicable to the work for which it is to be engaged.

The testing laboratory shall have its laboratory equipment and procedures inspected and approved annually by DDOT. In addition, testing machines and weighing devices must be calibrated as per AASHTO Designation R18 by impartial means using devices of accuracy traceable to the National Institute of Standards and Technology (NIST).

In fields other than those covered by the referenced AASHTO/ASTM Standards, the Contractor's own testing laboratory shall accept only those assignments that it is capable to perform competently by use of its own personnel and equipment. Any work to be subcontracted must be subcontracted to laboratories meeting the appropriate criteria.

The inspection and testing services of the testing laboratory shall be under the direction of a full-time employee certified by one of the States in the Mid-Atlantic States Region. They shall have experience in inspection and testing of the specific materials and construction they direct.

The supervisor of the laboratory and field technicians shall have documented experience of inspection and/or testing of materials involved in a related area of construction. Technicians must have a current Mid-Atlantic Region Technician Certification in their area of testing available for inspection.

It is the responsibility of the testing laboratory to provide the documents necessary to show continuing compliance with requirements outlined in this section.

## **107 LEGAL RELATIONS & RESPONSIBILITY TO PUBLIC**

### **107.01 RESTORATION OF SURFACES OPENED BY PERMIT**

The right to construct or reconstruct any utility service in a highway or street or to grant permits for same is expressly reserved by the Department and the Contractor shall not be entitled to any damages either for digging up a street or for any delay occasioned thereby.

When an individual, firm, or corporation is authorized to work in a street through a duly executed permit from the District, the Contractor shall allow parties bearing such permits, and only those parties, to make openings in the street. When ordered by the Chief Engineer, the Contractor shall make all necessary repairs due to such openings and the work will be paid for as provided in the contract documents or as extra work, and will be subject to the same conditions as similar work performed.

### **107.02 FEDERAL PARTICIPATION (FEDERAL-AID PROJECTS)**

Title 23 of the U.S. Code provides that when the U.S. Government participates in the cost of the work covered by the Contract, the work shall be under the supervision of the District but subject to the inspection and approval of the appropriate officials of the U.S. Government and in accordance with the applicable Federal Statutes, rules and regulations.

Such inspection will in no case make the Federal Government a party to this Contract, nor will it subject the Contractor to compliance with the Federal laws relative to labor on government contracts other than such labor requirements as are contained in the contract documents for the individual projects.

### **107.03 SANITARY, HEALTH AND SAFETY PROVISIONS**

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of employees as necessary to comply with the requirements and regulations of the District.

The Contractor and any subcontractors shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees. The Contractor shall comply with the current Federal Safety and Health Regulations for Construction.

### **107.04 PUBLIC CONVENIENCE AND SAFETY**

The Contractor shall at all times conduct the work in such manner as to insure the least possible obstruction to traffic. The safety and convenience of the general public and of the residents along the way shall be provided for in satisfactory manner.

### **107.05 RAILWAY-HIGHWAY PROVISIONS**

If the contract documents require that materials be hauled across the tracks of any railway, the Department will arrange with the railway for any new crossings required for or the use of any existing crossing. If the Contractor elects to use crossings other than those shown on the plans the Contractor shall make arrangements for the use of such crossings.

All work to be performed by the Contractor on the railroad right-of-way shall be performed at such times and in such manner as not to unnecessarily interfere with the movement of trains or traffic upon the track of the railway company. The Contractor shall use all care and precaution in order to avoid accidents, damage, or unnecessary delay or interference with the railway company's trains or other property.

#### **107.06 CONSTRUCTION OVER OR ADJACENT TO NAVIGABLE WATERS**

All work over, on, or adjacent to navigable waters shall be so conducted that free navigation of the waterways will not be interfered with and that the existing navigable depths will not be impaired except as allowed by permit issued by the U.S. Coast Guard and/or the U.S. Army Corps of Engineers, as applicable.

#### **107.07 BARRICADES AND WARNING SIGNS**

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be placed and maintained in accordance with the plans furnished. No signs, barricades, lights, or other protective devices shall be dismantled or removed without permission of the Chief Engineer.

All barricades, warning signs, lights, temporary signals, and other protective devices shall conform with the Manual on Uniform Traffic Control Devices for Streets and Highways and 616 Traffic Control of these specifications.

#### **107.08 EMERGENCY PROCESS**

The following is the process all companies shall follow when responding to emergency situations, defined as a threat to public safety or a situation in which a vital service\* has been disrupted:

- (1) Contact the Office of Infrastructure and Oversight.
- (2) Send notification through the online permitting system WEPS.DDOT.DC.GOV to the Office of Infrastructure and Oversight (by the next morning if situation occurs after business hours). Include location, size of cut (if known) and nature of work.
- (3) Apply for a permit within three (3) working days.
- (4) Submit, through the online permitting system WEPS.DDOT.DC.GOV., daily written up-date of work status.

\*Vital Service means providing electricity, gas, water, sanitary sewers, storm sewers or telephone services to a premises.

### **107.09 USE OF EXPLOSIVES**

Prior to any blasting procedure, the Contractor shall obtain the Engineer's written approval to blast as well as a permit from the Department of Consumer and Regulatory Affairs.

Blasting shall meet requirements of applicable sections, including "Explosives and Blasting", of the District's Safety Standards, Rules and Regulations-Construction. Warning signs shall meet requirements of "Blasting Procedures" in the District's signing manual.

The Contractor shall obtain blasting insurance with per person/occurrence limits of \$300,000/600,000 for bodily injury and occurrence/aggregate limits of \$50,000 for property damage. A specimen copy of this insurance shall be furnished and approved prior to start of blasting work.

The Contractor shall give utility companies sufficient notification.

Permission to blast may be revoked at any time if blasting requirements are violated or if blasting becomes hazardous; work then shall proceed by other means at no change in contract price.

The time blasting takes place will be determined solely by the Chief Engineer and shall be scheduled to provide minimum traffic interference. Blasts shall be recorded by seismographs furnished, installed and operated by the Contractor. Seismographs shall be located as directed. Upon completion of blasting, seismograph recordings with analyses shall be submitted to the Chief Engineer.

Any excavation, shattered rock, void, fault or other conditions created by blasting outside prescribed blast area shall be backfilled and repaired in an approved manner at Contractor expense.

All damage and injury caused by blasting operations shall be promptly repaired in an approved manner at Contractor expense.

### **107.10 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE**

The Contractor, including those under contract with the District and those operating under a public space permit, shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all Coast and Geodetic Survey, National Park Service, Metro or other survey markers or monuments. The Contractor shall not remove same until the respective authorities have been notified. The markers or monuments will be relocated by the respective authority. In the event they cannot be relocated in time for the Contractor to continue his operations without delay, the Contractor will be responsible for properly referencing their location. The Contractor shall be responsible for all damage or injury to property of any character during the prosecution of the work resulting from any act, omission, neglect, or misconduct in this manner or method of executing the work or at any time due to defective work or materials, and the Contractor's responsibility will not be released until the project has been completed and accepted.

The Contractor shall not disturb in any way trees, fences, utility poles, wires, structures and other appurtenances, public or private, without the explicit consent of the appropriate authority.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the non execution thereof by the Contractor, the Contractor shall restore at the Contractor's own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed or shall make good such damage or injury in an acceptable manner.

When approaching utilities, the Contractor shall give the owner thereof sufficient advance notice so the owner may accomplish any special measures needed. The Contractor shall provide any required access to utilization.

#### **107.11 NATIONAL HISTORIC PRESERVATION ACT OF 1966**

The Contractor agrees to contribute to the preservation and enhancement of structures and objects of historical, architectural, or archeological significance when such items are found and/or unearthed during the course of project construction. The Contractor shall act immediately to temporarily suspend work at the site of the discovery and to notify the Chief Engineer, who will immediately consult with the District of Columbia Historic Preservation Officer for recovery of the items.

All articles of historical or scientific value, including but not limited to coins, fossils, and articles of antiquity which may be uncovered by the Contractor during the progress of work, shall become District property.

#### **107.12 TREE PROTECTION AND REPLACEMENT**

- (A) **DESCRIPTION.** In carrying out the work of the contract the Contractor shall protect trees from damage during construction operations. Trees that are damaged or killed through neglect or failure to provide the necessary tree protection shall be replaced or compensation made as specified herein.
- (B) **CONSTRUCTION METHODS AND MATERIALS.** Protection from damage caused by equipment, fire, or carelessness shall include the following methods or measures:
1. All trees to be preserved shall be protected against damage during construction operations by fencing or armoring. The tree protection shall be placed before any excavation or grading is begun.
  2. No material shall be stored within 20 feet of any tree designated to be saved. Identification of species, location, size, and condition of trees to be preserved shall be done accurately on the topographic survey.
  3. Individual trees near heavy construction traffic shall be wrapped with burlap and 2 x 4 inch planks applied vertically and wired horizontally as armor around trunks. Spacing between planks shall be no more than 4 inches. Planks shall be 5 feet in length and their bottoms shall extend to 5 inches above ground level.

4. Individual trees or trees in groups near construction traffic shall be protected by fencing. Fences shall have posts equivalent to 4 x 4 inches set 3 feet in the ground and extending 5 above the ground. Posts shall be set at intervals not to exceed 8 feet set in a square around the tree(s). Vertical boards, 1 x 6 inch, shall be nailed to 2 walers. Space between vertical boards shall not exceed 6 inches.
5. Trees having low-hanging branches liable to injury shall be fenced around the outer perimeter of the spread of their branches. Fences shall be standard 48 inch high snow fence mounted on standard steel posts set not more than 6 feet apart.
6. Any damage done to existing tree crowns or root systems shall be repaired immediately by the Contractor under the direction of the Chief Engineer.

Roots exposed or damaged during grading operations shall immediately be pruned off cleanly inside the exposed or damaged area. Cut surfaces shall be painted with an approved tree wound dressing. Topsoil or well-rotted manure shall then be spread over the exposed area to a depth of 2 to 4 feet in a trench 1 foot wide in order to induce fibrous root system regeneration. Reconditioning of trees shall include removal of dead wood and suckering growth and pruning where necessary to promote proper growth in terms of form, branching, and foliage conservation. Trees shall be thoroughly watered at 10 day intervals throughout the growing season.

7. Fires for any reason shall not be made within 50 feet of any trees selected to remain.
8. If any trees designated to be saved are severely injured or killed by mechanical equipment or through neglect, they shall be replaced in kind by the Contractor at no cost to the District, or by the payment of a sum of dollars in fixed liquidated damage according to the following schedule:

2 to 6 inch caliper	\$ 250.00 per inch of caliper
over 6 to 12 inch caliper	\$ 400.00 per inch of caliper
over 12 inch caliper	\$1000.00 per inch of caliper

The caliper or diameter of the tree trunk shall be measured waist high above ground. Trees to be replaced in kind shall be planted in accordance with 611.02.

### 107.13 INSURANCE

The Contractor shall procure and maintain, during the entire period of performance under this contract, the types of insurance specified below. The Contractor shall submit a certificate of insurance giving evidence of the required coverages prior to commencing work. All insurance shall be written with responsible companies licensed by the District of Columbia's Department of Insurance, Securities and Banking. The Contractor shall require all subcontractors to carry the insurance required herein, or the Contractor may, at its option, provide the coverage for any or all subcontractors, and if so, the evidence of insurance submitted shall so stipulate. All insurance provided by the Contractor as required by this section, except comprehensive automobile liability insurance, shall set forth the District as an additional named insured. In no event shall work be performed until the required certificates of insurance have been furnished. The insurance shall provide for 30 days prior written notice to be given to the District in the event coverage is substantially changed, canceled or non-renewed. If the insurance provided is not in compliance with all the requirements herein, the District maintains the right to stop work until the proper evidence is provided.

- (A) **Commercial General Liability Insurance.** \$1,000,000 limits per occurrence, including coverage for Explosion, Collapse and Underground (XCU) and Incidental Pollution coverage, District added as additional insured.
- (B) **Automobile Liability Insurance.** \$1,000,000 per occurrence combined single limit.
- (C) **Worker's Compensation Insurance.** According to the statutes of the District of Columbia, including Employer's Liability, \$100,000 per accident for injury, \$100,000 per employee for disease, \$500,000 policy limit disease; if work is on or near navigable waterways, USL&H coverage (federal statutory limits) must be included
- (D) **Umbrella/Excess Liability Insurance.** \$5,000,000 limits per occurrence. Magnitude of contract may require higher limits. Contractor shall confirm required coverage with DCORM.
- (E) **Architect's and Engineer's Errors and Omissions Liability Insurance.** Limits of \$1,000,000 per claim.

#### **107.14 OPENING OF SECTIONS OF PROJECT TO TRAFFIC**

Whenever, in the opinion of the Engineer, any roadway or portion thereof is in acceptable condition for travel, it shall be opened to traffic, as may be directed, and such opening shall not be held to be in any way an acceptance of the roadway or any part of it, or as a waiver of any of the provisions of these specifications and contract.

#### **107.15 CONTRACTOR'S RESPONSIBILITY FOR WORK**

Until final acceptance of the project by the Engineer, the Contractor shall be responsible for the project and shall take every precaution against injury or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable cause beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God, or acts of the public enemy or of governmental authorities.

In case of suspension of work from any cause whatever, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project, provide for normal drainage and shall erect any necessary temporary structures, signs, or other facilities. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seeding, and sodding furnished under the contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

#### **107.16 UTILITY PROTECTIVE ALERT**

At least 72 hours, but not more than 10 days (excluding Saturday, Sunday and holidays) in advance of proceeding with excavation or demolition work necessitated by this Contract, the Contractor shall notify the following parties, by telephone, of the impending excavation or demolition and the location thereof:

NAME	TELEPHONE NO.	FACILITIES
“Miss Utility” for Wash. Gas. Light Co., Verizon, PEPCO, AT&T Water and Sewer Authority	1-800-257-7777	gas lines; telephone, electric and communication conduit and cables
	202-698-3600	watermains
	1-800-257-7777	sewers
	202-698-3600	electrical systems
	202-698-3605	street lighting inspection
	202-671-2610	traffic signal system
GSA*	202-708-4895	
	202-690-9720	steam piping steam tunnel and condenser water conduit

\*GSA shall be contacted only if excavation work will occur within the following areas:

**Northwest**

South of H Street  
West of First Street  
East of Rock Creek Parkway

**Southwest**

North of D Street  
West of Third Street  
East of Seventeenth Street

The Contractor shall not proceed with work until utility facilities have been located, disconnected or otherwise adjusted by utility representatives. Hand digging is required within 18 inches from the nearest point of a natural gas line. D.C. Government contractors may hand dig a test pit to locate the line. In either case, the Contractor shall use care to avoid damage to all underground facilities. If an underground facility is damaged, under no circumstances shall a contractor backfill an excavation without first receiving permission from the utility operator whose facility was damaged.

**107.17 ENVIRONMENTAL PROTECTION**

**(A) WATER QUALITY.**

- (1) **DESCRIPTION.** The Contractor shall provide temporary measures to control soil erosion and sediment through the use of swales, dikes, sediment basins or traps, berms, silt fences, dams, paved chutes or flumes, riprap, fiber mats, netting, gravel, mulches, grasses or other devices or methods. Permanent control provisions, contained in the contract shall be coordinated with the temporary control provisions to the extent practical to assure economical, effective and continuous control throughout the construction and post-construction periods.

The District of Columbia Department of Transportation has adopted the D.C. Department of Health (DOH), Environmental Health Administration, Bureau of Environmental Quality, Watershed Protection Division “2003 Standards and Specifications for Soil Erosion and Sediment Control” and the District of Columbia “Erosion and Sediment Control Handbook”. All work described herein shall be

performed in strict conformance with the requirements of Standards and Specifications and in accordance with the erosion control regulations in the current Title 21 of D.C. Municipal Regulations (DCMR 21). Copies of the referenced publications are available to persons at the One Stop Permit Office, 941 North Capitol Street, N.E., Washington, D.C. 20002 (202-492-4648).

- (2) **CONSTRUCTION REQUIREMENTS.** Prior to the start of any land disturbing activity, the Contractor shall submit for approval his written proposals and schedules for accomplishment of soil erosion and sediment control work. The proposals and schedules shall be submitted to the Chief, QA/QC, Department of Transportation for approval. No work on land disturbing activities is to be started until the control proposals, schedules, and methods of operation have been received and approved.

The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, and by excavation, borrow and fill operations. The Engineer may direct the Contractor to provide immediate permanent or temporary control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment, and to prevent damaging erosion or sediment deposits into the sewer system or on neighboring lands. Such work may involve the construction of interim berms, dikes, dams, sediment basins, and slope drains, and use of interim mulches, mats, seeding, or other control devices or methods as necessary to control erosion and sedimentation. Fill and cut slopes shall be seeded and mulched as the excavation proceeds to the extent considered desirable and practicable. In some instances, incremental heights of slopes for sequential seeding and mulching will be specified.

The Contractor shall be required to incorporate all permanent erosion and sediment control features into the project at the earliest practicable time as outlined in his accepted schedule. Temporary erosion and sediment control measures will be used as needed to correct conditions that develop during construction that were not foreseen during the design stage; as needed prior to installation of permanent control features; and as needed temporarily to control erosion or sedimentation that develops during normal construction practices but are not associated with permanent control features on the project.

Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion and sediment control features can follow immediately thereafter if the project conditions permit; otherwise, temporary control measures may be required between successive stages. Under no conditions shall the surface area of erodible earth material exposed at one time by clearing and grubbing exceed 50,000 square feet without approval of the Engineer. The limitation will apply to clearing operations only unless exempted by the Engineer.

The Engineer will limit the area of excavation, borrow, and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent erosion and sediment control measures current in accordance with the approved schedule. Should seasonal limitations make such coordination unrealistic, temporary control measures shall be taken immediately to extent feasible and justified.

Under no conditions shall the amount of surface area of erodible earth material exposed at one time by excavation, borrow, or fill within the right-of-way exceed 50,000 square feet without prior approval by the Engineer. This is in addition to the limitation on clearing and grubbing previously set forth.

The Engineer may increase or decrease the surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow, and fill operations as determined by an analysis of project conditions. The roadbed area will be included in the surface area limitations if site conditions are judged to be unfavorable by the Engineer. Erosion and sediment control measures shall be required on construction work outside the right-of-way where such work is necessary as a result of roadway construction. Included are borrow pit operations, haul roads and equipment storage sites within the District of Columbia.

The erosion and sediment control features installed by the Contractor shall be acceptably maintained by the Contractor until accepted by the District.

In the event of conflict between these requirements and laws, rules, or regulations of other Federal or State or local agencies, the more strict laws, rules, or regulations shall apply.

The Contractor shall be fined \$500.00 per day/per occurrence for failure to provide and/or properly maintain approved erosion and sediment control, as determined by the Chief Engineer.

- (3) **MEASURE AND PAYMENT.** Unless otherwise provided in the Special Provisions, no measure or payment will be made and the cost of meeting requirements of this article shall be reflected in and distributed among the contract pay items.

Temporary erosion control measures required due to Contractor negligence, carelessness, or failure to install permanent controls as scheduled shall be at Contractor expense.

The Engineer reserves the right to employ outside assistance or to use District forces to provide needed erosion control measures if the Contractor fails to do so. Such incurred direct cost plus project engineering cost will be charged to the Contractor.

**(B) STORMWATER MANAGEMENT.**

- (1) **GENERAL.** The Contractor shall be responsible for providing a stormwater management plan which complies with all aspects of Section 509-518 of D.C. Law 5-188. In general, the plan shall be designed in accordance with the D.C. Department of Health (DOH), Environmental Health Administration, Bureau of Environmental Quality, Watershed Protection Division "Stormwater Management Guidebook". Included shall be plans, details, computations and related data for the design and construction of stormwater infiltration, detention, retention or attenuation structures or any other devices necessary to abate pollution or control runoff from the site.

Copies of the Stormwater Management Guidebook may be obtained from the One-Stop Permit Office, 941 North Capitol Street, N.E., Washington, D.C. 20002.

- (2) **MEASURE AND PAYMENT.** Unless otherwise provided in the Special Provisions, no measure or payment will be made and the cost of meeting requirements of this article shall be reflected in and distributed among the contract pay items.

**(C) AIR QUALITY CONTROL.**

- (1) **GENERAL.** The Contractor shall take necessary action to comply with requirements of the air quality control Regulations in the current Title 20 of the District of Columbia Municipal Regulations (DCMR 20), "Environment and Energy", available at the Publication Office in the District Building.

- (2) **CONTROL OF FUGITIVE DUST.** All work and storage space shall be designed and maintained so that fugitive dust (solid, airborne particulate matter emitted from any source other than through a stack) is kept to a minimum.

The Contractor shall take necessary precautions to assure that no person will cause, suffer, allow or permit any materials to be handled, transported, or stored, or a building and its appurtenances, or a road, to be used, constructed, altered, repaired, or demolished without taking reasonable precautions to prevent particulate matter from becoming airborne. The Contractor's reasonable precautions shall include, but are not limited to the following:

- (a) Use of water or chemicals, where possible, for control of dust in the demolition of existing structures, construction operations, the grading of roads, or the clearing of land;
  - (b) Application of asphalt, oil, water, or suitable chemicals on dirt roads, materials, stock piles, or other surfaces which can create airborne dusts;
  - (c) Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials, and employment of adequate containment methods during sand blasting or similar operations;
  - (d) Covering, at all times when in motion, the contents of open bodied trucks transporting materials likely to become airborne;
  - (e) Paving of roadways and their maintenance in a clean condition;
  - (f) Prompt removal of earth or other material from a paved street, where the earth or other material has been transported thereto or accidentally deposited by trucking or earth moving equipment or erosion by water.
- (3) **VISIBLE EMISSIONS.** All construction equipment used on the construction project shall meet the following emission requirements of the DC Air Quality Control Regulations:

Except as otherwise provided in the DC Air Quality Control Regulations, no person shall cause, suffer, or allow to be emitted into the outdoor atmosphere, visible emissions from stationary sources: Provided that discharges not exceeding forty percent (40%) capacity (unaveraged) shall be permitted for two (2) minutes in any 60 minute period and for an aggregate of twelve (12) minutes in any twenty four (24) hour period. These discharges shall be allowed only for "start-up", cleaning,

soot blowing, adjusting combustion controls, or malfunction of equipment. Where the presence of uncombined water is the only reason for failure of an emission to meet the requirements of this section, this section shall not be applicable.

- (4) **EXHAUST EMISSIONS.** No person, nor his employees nor agents, shall cause, suffer, permit or allow the engine of a gasoline, or diesel powered motor vehicle including private passenger vehicles, on public or private space to idle for more than 3 minutes while such motor vehicle is parked, stopped or standing, except as follows:
- (a) To permit the operation of power takeoff equipment such as, but not limited to dumping, cement mixers, refrigeration systems, content delivery, winches, or shredders.
  - (b) To permit the operation of heating equipment when the local temperature is 32°F or below.
- (5) **EQUIPMENT.** The Contractor shall use, where possible, diesel powered vehicles and equipment.
- (6) **OPEN BURNING.**
- (a) Prohibition of Open Burning. Except as otherwise provided by subsection (b), no person shall ignite, cause to be ignited, permit to be ignited, or maintain, any open fire.
  - (b) Exceptions. Open fires may be permitted for one or more of the following reasons or purposes:
    - (1) Prevention of a fire hazard which cannot be abated by other means; or,
    - (2) Providing warmth for construction or other workers by use of salamander heaters or other heating methods approved by the Engineer.

**(D) NOISE.**

- (1) **GENERAL.** The Contractor shall conduct all operations for the prosecution of the work in compliance with the regulations set forth below controlling maximum noise levels due to construction work. At the site of the work special precautions and noise abatement measures shall be taken by the Contractor in order to reduce exposure to noise. In addition to the specified sound measurements required herein, the Contractor shall conduct measurements whenever the Engineer determines any noises to be excessive.
- (2) **HEALTH AND SAFETY ACT.** The Contractor is required to meet the standards of the Federal Occupational Safety and Health Act of 1971 or most recent revision thereof.
- (3) **MEASURING SOUND LEVELS.** Sound levels as specified herein shall be measured on a sound level meter conforming to American National Standard Specifications for Sound Level Meters, S 1.41971 or its latest revision for Type I (Precision) or Type II (General Purpose) Sound Level Meters.
- (4) **PUBLIC NOISE EXPOSURE.** Sound levels for public noise exposure due to construction will be measured at the point adjacent to the site of the work in normal

use by the public while construction work is in progress. These sound levels shall be measured on the A Scale of a sound meter at slow response. These sound levels may not exceed the following:

<b>Duration per day in hours</b>	<b>Sound level in dBA</b>
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

Sound level for impulsive or impact noise (noise of duration less than one second) shall not exceed a peak sound pressure level of 140 dB when measured on an approved impact noise analyzer. In lieu of the above procedure, 125 dB measured on the C Scale of a sound level meter at fast response will be accepted as an equivalent measure of the peak sound pressure level.

Impact noise generating equipment may only be used during the hours of 7:00 a.m. to 10:00 p.m., Monday through Friday.

- (5) **ADDITIONAL SOUND LEVELS.** Additional sound levels for noise due to construction will be measured at the street line of the structure adjacent to and along the area of the Contractor’s operation’s and plant. Sound levels measured on the A Scale of a sound level meter set for slow response shall be at the street line and shall not exceed the following:

**Residential Structures:**

Daily, except Saturday and Sunday, 7:00 a.m. to 10:00 p.m. - 75 dBA

Daily 10:00 p.m. to 7:00 a.m. and 10:00 p.m. Friday to 7:00 a.m. Monday - 60 dBA

**Factory – Commercial Structures:**

90 dBA, unless otherwise permitted by the Engineer.

- (6) **NOISE CONTROL REQUIREMENTS.** In connection with the observance of noise control requirements the Contractor shall provide such equipment, sound deadening devices and take such noise abatement measures that are necessary to comply with the requirements of the contract, consisting of, for example, the following:

- a. Shields or other physical barriers to restrict the transmission of noise.
- b. Sound proofing housing or enclosures for noise producing machinery.
- c. Use of electrically operated hoists and compressor plants, unless otherwise permitted by the Engineer.

- d. Silencers on air intakes of equipment.
- e. Maximum sized intake and exhaust mufflers on internal combustion engines.
- f. Gears on machinery designed to reduce noise to a minimum.
- g. The prohibition of the use of air or gasoline driven saws, unless otherwise permitted by the Engineer.
- h. Conducting the operation of hauling construction materials in trucks so that noise is kept to a minimum.
- i. Routing of construction equipment and vehicles carrying rock, concrete or other materials over streets that will cause the least disturbance to residents in the vicinity of the work.

### **107.18 WATER SUPPLY**

The Contractor shall obtain a permit from the D.C. Water and Sewer Authority Representative at 941 North Capitol Street, N.E., Washington, D.C. (202-442-4648) to use water for construction purposes from public hydrants or to connect to the water system with a temporary tap.

If the Department determines that fire hydrant water may be used, the Contractor shall be charged the WASA-designated rate per working day.

If the Department determines a temporary water main tap is required, the Contractor shall excavate a pit for a tap as directed, excavate the trench and install water service piping. The District will make the tap, furnish and install a meter at no cost to the Contractor. Temporary water taps require a \$250.00 permit fee plus a \$1,000.00 deposit. At completion of the Contract, the Contractor shall excavate a pit for tap removal by the District, excavate and remove water service piping and backfill to the satisfaction of the District. The District will remove the water meter at no additional cost to the Contractor.

The District will keep an account for direct payment by the Contractor of water and sewer charges.

On EPA funded projects, the District will install a meter on water services to the Contractor's Field Office and the Engineer's Facilities (field office). The Contractor will not be charged for this water usage.

River and stream water shall not be used. Water from a source other than a hydrant or tapped water main will be subject to test per AASHTO T26.

### **107.19 CIVIL RIGHTS**

The applicable provisions of Title VI of the Civil Rights Act of 1964, as amended, apply to this Contract for both the prime Contractor, all subcontractors, and all suppliers, vendors and/or manufacturers.

## 108 PROSECUTION AND PROGRESS

### 108.01 SUBLETTING OF CONTRACT

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the Contract or Contracts or any portion thereof, or of the right, title, or interest therein, without the consent of the Contracting Officer. If such consent is given, the Contractor will be permitted to sublet a portion of the work. For Federal-Aid projects, the Contractor shall perform with his own organization, work amounting to not less than 30 percent of the total contract cost, unless a different percentage is specified in the contract. Any items designated in the contract as "Specialty Items" may be performed by subcontract and the cost of any such specialty item may be deducted from the total cost before computing the amount of work required to be performed by the Contractor's own organization. No subcontracts, or transfer of contract shall relieve the Contractor of his liability under the contract and bonds.

The request to the Contracting Officer for subcontracting approval shall contain the following information:

- a. Subcontractor's name, address, telephone number and Federal Social Security Number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
- b. Estimated dollar amount of the subcontract.
- c. Estimated starting and completion dates of the subcontract.

When specifically required in the contract proposal the prime Contractor shall award at least 50 percent of his subcontracts to certified minority business enterprises; bid documents will contain a certification form to be signed by bidders to this effect.

### 108.02 NOTICE TO PROCEED

The Contractor shall start work on the date specified in a written Notice to Proceed issued by the Contracting Officer, and shall complete the work within the period specified in the Special Provisions.

### 108.03 CONSTRUCTION SCHEDULING

Prior to commencing any work, the Contractor shall submit his construction schedule to the Engineer for approval.

- (A) **GENERAL.** Sequence of operations and dates for all major stages of work shall be shown on the schedule. Work under pay items shall not commence until schedule is approved. The Contractor shall regulate his operations, plant, work shifts and work force to maintain the approved schedule.

Any time the Contractor falls more than 5 percent, or 4 weeks, whichever is the longer time, behind the approved schedule, he shall promptly upon written notice from the Engineer increase his work force, equipment and working hours in order to put the project on schedule. For delays or portions of delays for which the Contractor is responsible, no payment will be made for increase in work force equipment and working hours needed to put the project on schedule.

**(B) CPM SCHEDULING.** The progress schedule shall be based on CPM scheduling and shall include the following:

1. Site organization plan showing locations of administrative facilities, storage and parking areas, traffic flow scheme within project site, site ingress and egress, sanitary facilities, maintenance areas, temporary utility connections, and any other information considered appropriate for proper site management.
2. Schedule showing sequence and timing of first month's operations.
3. Within 20 consecutive calendar days after notice to proceed date, a CPM Network Diagram similar to that described in the Associated General Contractors' book "CPM In Construction Manual for General Contractors." The Arrow Diagram shall contain a separate and distinct activity arrow designation for each activity of work. Items shown in the Pay Item Schedule will not necessarily be considered activities. Each activity arrow shall have a notation including a brief work description and a duration estimate in working days. Inter-dependency relationship of all activities shall be shown. At all times, sequence of work shall take into consideration provisions for Maintenance of Highway Traffic.

The schedule for Arrow Diagram Activities shall indicate:

- a. Status of each activity on the Critical Path;
  - b. Earliest starting date for each activity;
  - c. Earliest finishing date for each activity;
  - d. Latest starting date for each activity;
  - e. Latest finishing date for each activity;
  - f. Amount of float time available.
4. The Contractor shall submit a continuous resource analysis indicating the minimum resources required (i.e., man-power for each trade, equipment, etc.) for each critical path activity shown on the CPM schedule.

Within 7 consecutive calendar days after the Arrow Diagram has been returned to him, the Contractor shall revise as requested and resubmit the Arrow Diagram to the Engineer for approval. The Contractor shall use the approved Arrow Diagram for all project scheduling and shall submit to the Engineer 5 copies each of the approved Arrow Diagram and work schedule.

The schedule shall be regularly monitored by the Contractor so as to produce revised work schedules bi-weekly to reflect activities added, deleted, changes, started and completed.

If the contract work falls more than 5 percent or 4 weeks, whichever is longer, behind the approved schedule and when directed by the Engineer, the Contractor shall produce and submit a revised Arrow Diagram and resource analysis.

**108.04 LIMITATION OF OPERATIONS**

The Contractor shall conduct the work at all times in such a manner and in such sequence as will assure the least interference with traffic. He shall have due regard to the location of detours and to the provisions for handling traffic. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

**108.05 METHODS AND EQUIPMENT**

All equipment necessary for the completion of the work shall be of sufficient size and in first-class working condition and must have been inspected and approved by the Engineer before that portion of the construction on which the equipment is to be used will be permitted to begin. The equipment shall be maintained in a first-class operating condition throughout its use on the project for which it is approved.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than specified in the contract, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as a result of authorizing a change in methods or equipment under these provisions.

**108.06 DETERMINATION OF CONTRACT TIME AND PARTIAL SUSPENSION**

- (A) **CONTRACT TIME.** The number of days allowed for completion of the work included in the contract will be stated in the contract documents and will be known as contract time.

When the contract time is on a calendar day basis, it shall be counted from the effective date on the Notice to Proceed and shall include all working days and non-working days, including Sundays and Holidays.

All calendar days elapsing between the effective dates of any orders of the Contracting Officer to suspend work and to resume work for suspensions not the fault of the Contractor shall be excluded.

Adjustments will also be made for periods of partial suspensions as defined below.

- (B) **PARTIAL SUSPENSION.** The performance of work under the contract may, by written order of the Contracting Officer, be partially suspended during the period from December 1st to April 1st inclusive, or during such other periods as the Contracting Officer may determine necessary due to weather, soil or other conditions considered unsuitable for

prosecution of the work. Suspension of work on some but not all items of work shall be considered partial suspension.

During periods of partial suspension, the number of calendar days to be charged as contract time shall be computed by multiplying the number of calendar days of original contract time by the ratio of the amount earned during the period of partial suspension to the original contract amount. In no case shall the number of calendar days charged as contract time for a period of partial suspension exceed the total elapsed time of the partial suspension.

- (C) **UTILITY DELAYS.** The Contractor shall consider the location of existing utilities in determining contract time. The Contractor is warned that delays of a minor nature, encountered through required utility adjustments by others or imprecise utility location information, have been considered, and delays resulting therefrom may not serve as a basis for time extensions.

**108.07 FAILURE TO COMPLETE ON TIME**

For each calendar day that contract work remains uncompleted after expiration of the contract time or main part thereof, the sum in the table below will be deducted as liquidated damages from any money due the Contractor. The Contractor’s operations after expiration of construction completion time as extended will in no way waive the District’s rights under the contract.

<b>More Than</b>	<b>to and Incl.</b>	<b>Calendar Day Charge</b>
\$0	\$100,000	\$200.00
100,000	500,000	400.00
500,000	1,000,000	650.00
1,000,000	2,000,000	800.00
2,000,000	4,000,000	950.00
4,000,000	7,000,000	1,100.00
7,000,000	10,000,000	1,350.00
10,000,000	20,000,000	1,500.00
20,000,000	-----	1,700.00

**108.08 PROGRESS PHOTOGRAPHS**

Suitable photographs shall be taken by the Contractor at each project site. View locations will be designated. One hundred and fifty (150) original photographs will be required. Approximately twenty (20) photographs shall be taken prior to start of work, and approximately twenty (20) photographs shall be taken after completion of construction. The remainder shall be taken throughout the construction period on a monthly basis.

Photographs shall be color, 8 x 10 inches in size, with an inch flap at the left side for binding. They shall be properly identified as to project and view taken, date taken, and numbered consecutively in the order taken starting with No. 1. This information shall be placed in the bottom margin. Three copies and a negative of each view shall be furnished to the Engineer as soon as practicable.

Sample progress photographs are available at the Construction Office of the Department of Transportation.

Measurement for Progress Photographs will be the job.

Payment for Progress Photographs will be at the Contract Lump Sum price, which payment will include all labor, tools, equipment and incidentals necessary to produce the required photographs.

#### **108.09 DIMENSIONS OF EXISTING FACILITIES**

Dimensions and locations of existing facilities are not necessarily exact. Where installation or connection of any part of the work to existing facilities are required, the Contractor shall verify such dimensions and locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

#### **108.10 ADVERSE WEATHER PRECAUTIONS**

During adverse weather, the Contractor shall take necessary precautions so that the work may progress properly and is satisfactory in all respects.

During hot weather, and cold weather below 40°F, any part of the work that is temperature dependent shall be properly protected.

#### **108.11 PRECONSTRUCTION SURVEY**

Prior to starting any work, the Contractor shall make a detailed inspection of buildings, structures, roadways, sidewalks, retaining walls, landscaping, and related surface improvements adjacent to and in the vicinity of the proposed work, wherever located. The inspection shall include notes, measurements, and a video cassette tape (or VHS format 1/2 inch tape), with audio sound track, of all facilities prior to the start of construction. The audio description of the inspection shall include the date, time, weather conditions, address/stationing/location, brief description of the facility, and description of physical conditions encountered.

Two copies of all notes, measurements, video tapes, reports, and data shall be submitted to the Engineer, accompanied by a completed Department of Transportation standard transmittal form, as soon as these records are complete and prior to start of any construction activity. Progress payments will not be made until this requirement is met.

No additional compensation over and above that reflected in the Schedule of Prices will be allowed for complying with this provision.

#### **108.12 AS-BUILT DRAWINGS**

During the entire construction period, the Contractor shall maintain one complete record set of Contract Drawings on which he shall annotate, in a timely manner, all deviations, field changes, changes accomplished by change order, as constructed depths of footings and structural elements, horizontal and vertical locations of underground electrical and utility facilities referenced to survey data and temporary construction left in place (if permitted).

The Engineer will furnish to the Contractor electronic files (CD ROM or diskettes) of the Contract Drawings for use in preparation of as-built drawings by addition of information from the annotated record set. As-built information shall be entered in the electronic files by and shall be certified by an officer of the company as follows:

**AS BUILT**

(Date)

I certify that this drawing accurately  
depicts the work as constructed.

(An Officer of the Contractor's Company)

Signature                      Title

CONTRACTOR'S NAME

The Contractor shall then prepare and deliver to DDOT's Infrastructure Project Management Administration (IMPA) two (2) CD ROM copies of the electronic files of the final As-Built drawings, the modified reproducible set, five (5) bound half size sets on bond paper and one additional CD ROM with As-Built information of street lighting plans only.

Unit of measure for AS-Built Drawings will be the job. No measure will be made for this work. Payment for As-Built Drawings will be made at the lump sum price, which payment will include all performance of work as specified herein.

## 109 MEASURE AND PAYMENT

### 109.01 MEASUREMENT OF QUANTITIES

All work under the contract will be measured by the Engineer according to United States standard measure.

Measure will be taken only within designated limits as indicated or intended by the plans or as directed or computed to provide correct limits in accordance with intent of work and the project.

Pay items with units of measure on a linear or area basis will be computed from actual surface measure and/or plan dimensions, as altered to meet field conditions.

No deduction will be made in area measure for any individual fixture with an exposed area of 9 square feet or less.

Materials measured or proportioned by weight shall be weighed on accurate approved scales by qualified personnel at approved locations unless theoretical weights are permitted. Ton measure shall mean 2000 pounds avoirdupois.

Net certified scale weights, or rail shipment weights based on certified volumes, will be basis of weight measure subject to correction for loss as determined.

When volume measure is specified, material may be weighed when approved and converted to volume measure. Factors for conversion from weight measure to volume measure, unless provided in specifications, will be determined by the Engineer.

Volume measure will be computed at 60°F or corrected to volume at 60°F, using ASTM D 1250 for asphalts and ASTM D 633 for tars.

Pay items with a job unit measure shall include all necessary fittings and accessory work needed to complete intent of the work.

Unless more rigid tolerances are required by specifications, established industry manufacturing tolerance will be accepted.

### 109.02 SCOPE OF PAYMENT

The Contractor shall receive and accept compensation provided by contract pay items as full payment for furnishing all materials and for performing all contract work in a complete and acceptable manner including all labor, plant and incidentals needed, and for all risk, loss, damage or expense of whatever nature arising from the work and its prosecution, subject however to contract provisions.

If payment clauses require that payment include compensation for certain work or material accessory to pay item, the amount of this included work or material will not be measured nor will payment be made under any other contract pay item.

Where 2 or more pay item areas overlap either by discrepancy in definition or by the intricate nature of work, payment will be made at the lowest contract unit price of overlapping pay items involved.

The phrases “work includes” and “as part of work” are sometimes used to clarify that referenced requirements shall be included as part of the pay item involved; no separate or additional payment will be made.

The phrase “at Contractor expense” means the Contractor shall meet requirements as his sole expense with neither liability nor expense to the District. The phrase normally refers to repair of unacceptable work due either to the Contractor’s operation or to the Contractor’s failure to take reasonable or specified precautions.

### **109.03 EXTRA AND FORCE ACCOUNT WORK**

Whenever the parties fail to agree on an equitable adjustment in price for change order work or in the processing of claims, the following supplements the basis of the cost breakdown defined in subsections 1 through 7 of Section D, Article 3 of the Contract General Provisions.

3. **Materials** – Payment for cost of required materials will be F.O.B. the job site with an allowance of up to 15 percent to cover overhead and profit. For landscape plantings, up to 25 percent will be allowed to cover overhead and profit.
4. **Rented Equipment** – The current edition of the Rental Rate Blue Book for Construction Equipment published by Data Quest shall be used to determine the equipment rental rates in lieu of the AED specified in Article 3, Section D, paragraph 4 of the Contract General Provisions.
5. **Contractor’s Equipment** – Payment for required equipment owned by the Contractor or an affiliate of the Contractor will be based solely on an hourly rate derived by dividing the current appropriate monthly rate from the Rental Rate Blue Book for Construction Equipment published by Data Quest by 176 hours. No payment will be made under any circumstance for repair cost, freight and fuel, lubricants, insurance, any other costs and expenses, or overhead and profit. Payment for such equipment made idle by delays attributable to the District will be based on one-half the derived hourly rate under this subsection. Approved transportation charges will be paid (one way) from the nearest source if the equipment is brought up to the project specifically for use on the change order work and is not to be used on any other work.
8. **Liability Insurance** – When additional liability insurance is required the payment for the additional insurance will be based on the additional premiums, to which up to 5 percent of additional premium will be allotted to cover handling.

### **109.04 ELIMINATED ITEMS**

Should any pay items contained in the proposal be found unnecessary for the proper completion of the work, the Engineer may, upon written order to the Contractor, eliminate such pay items from the contract, and such action shall in no way invalidate the contract. When the Contractor is notified of the elimination of pay items, he will be reimbursed for actual work done and all costs incurred, including mobilization of materials prior to said notification.

**109.05 PROGRESS PAYMENTS**

Progress payments will be made at least once a month based upon estimates prepared by the Engineer of the value of work performed and materials complete in place in accordance with the contract and for materials delivered in accordance with 109.07.

No partial payment will be made when the total value of work performed since last estimate amounts to less than \$300.00.

**109.06 PAYMENT TO SUBCONTRACTORS AND SUPPLIERS CERTIFICATE**

The Contractor, prior to receiving a progress payment, shall submit to the Contracting Officer certification that the Contractor has made and will make timely payments to his subcontractors and suppliers per his contractual arrangements with them.

Certification shall be made on the form prescribed.

**109.07 PAYMENT FOR STOCKPILED MATERIALS**

Payment for stockpiled materials shall be included in the monthly progress payments providing the following conditions are met:

1. The stockpile site is under the control of either the District or the Contractor and will remain so until the material is incorporated in the work. If the site is under the control of the Contractor, proof of such control shall be submitted to the District.
2. Appropriate test reports, if required, shall be submitted to the District which show that the materials meet the requirements of the contract.
3. Contractor requests for payment shall be in writing and shall include the written consent of the surety.
4. Copies of suppliers' invoices shall accompany all requests for payment. Copies of paid invoices for materials shall be submitted to the District within one (1) month after the Contractor has received payment for the materials. Failure to provide timely submissions of paid invoices shall be cause to deduct payment for the materials from the subsequent monthly progress payment.
5. Payment shall be limited to the following stockpiled materials unless specifically approved by the Engineer: sewer pipe, water pipe, water and sewer valves, guiderail, electrical work materials, mechanical work materials, piling, PCC form materials, reinforcing steel, prestressed concrete beams, structural steel, paint, stone masonry, railing, bridge deck drainage, steel sign structures, and wall tile.

No payment will be made for invoices less than \$2,000.00. No payment greater than \$100,000.00 shall be for stockpiled materials, for any given month.

**109.08 ACCEPTANCE AND FINAL PAYMENT**

When the project has been accepted as provided in ARTICLE 12, of the General Provisions, the Engineer will prepare the final estimate for the work performed. If the Contractor approves the final estimate and does not file an exception to the quantities therein final payment will be made.

With approval of such final estimates by the Contractor, payment will be made for the entire sum found to be due after deducting all previous payments and all amounts to be retained or deducted under the provisions of the Contract.

If the Contractor files a claim in accordance with contract requirements, it shall be submitted in writing in sufficient detail to enable the Engineer to ascertain the basis and amount of such claim. In such cases the final sum determined by the Engineer to be due will be paid pending study of the claim. Upon final adjudication of the claim any additional payment determined to be due the Contractor will be placed on a supplemental estimate and processed for payment.

All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

## **DIVISION 200 EARTHWORK AND EXCAVATION**

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## 201 CLEARING AND GRUBBING

### 201.01 DESCRIPTION

Clearing shall consist of the removal from above the surface of the existing ground of all trees, shrubs, brush, down timber, rotten wood, heavy growth of grass, rubbish and other objectionable debris or deleterious material as directed by the Chief Engineer, as well as the removal of fences, signs and incidental structures.

Grubbing shall consist of the removal from below the surface of the existing ground of all stumps, roots, root mats, stubs, buried logs and other objectionable debris or deleterious material as directed by the Chief Engineer. Prior to beginning grubbing operations, the Contractor shall install approved erosion and sediment control devices.

Materials obtained from clearing and grubbing shall be disposed of as provided herein, except that such materials as the Engineer may designate shall be salvaged. If necessary, salvaged materials shall be stockpiled within the project limits but away from any proposed construction. Any additional charges or payment for hauling or delivering salvaged materials shall be negotiated.

### 201.02 LIMITS

This work shall be performed within the limits of earthwork operations as described herein. Within areas where Common Excavation is to be performed, the ground shall be totally cleared as described above, and grubbing shall be done to a depth of not less than 1 foot below the sub-grade or finished slope surfaces. This is not intended to include removal of unsuitable roadbed material.

Within areas where embankment is to be constructed, the ground shall be totally cleared for a width of 2 feet outside of the toe of the embankment. When the embankment is 8 feet or more in height, stumps shall be removed as close to the ground as possible, but no stump shall be left higher than 12 inches above the existing ground surface.

Within areas where the embankment is less than 8 feet in height, the ground shall be totally grubbed to a depth of not less than 1 foot below the original ground surface.

Within areas where structural excavation is to be performed, total clearing and grubbing shall be performed prior to start of structural excavation.

Areas beneath the structure and for a transverse distance beyond the outermost side limits of the structure, not to exceed 20 feet, shall be cleared and grubbed as directed by the Chief Engineer.

The Contractor shall perform the work of clearing and grubbing so as to remove only the material herein specified.

### 201.03 CONSTRUCTION REQUIREMENTS

Before clearing and grubbing operations are started, the Chief Engineer will designate and clearly mark any trees, shrubs and plants to remain. All such trees, shrubs and plants shall be carefully trimmed and protected from scarring, barking or other injury during construction

operations. All cuts and scars on trees shall be painted and treated with an asphalt base paint especially prepared for tree surgery, as directed by the Chief Engineer. All timber, logs, trees, stumps, brush, materials from demolished structures and other rubbish shall be disposed of satisfactorily by the Contractor so as to leave the disturbed areas with a neat and finished appearance, free from debris. Burning will not be permitted. All materials removed during the clearing and grubbing operations shall become the property of the Contractor, except for designated salvaged material.

All depressions made in fill areas by the removal of stumps or similar objects shall be backfilled with suitable on-site or borrow materials, as directed, and compacted in accordance with 203.03.

Fences, shrubs, ornaments and other privately owned articles that are in the line of the paving and in public space are to be removed by the property owner in advance of paving however, in the event the owner has not removed these items when the work is ordered commenced, the Contractor, at the direction of the Chief Engineer, shall remove and set these ornamental objects on the private properties affected, well out of the way of construction.

#### **201.04 MEASURE AND PAYMENT**

The unit of measurement for Clearing and Grubbing will be the job. Payment will be made at the contract lump sum price, which payment will include all labor, materials, disposal of materials, tools, equipment and incidentals necessary to complete the work as specified herein.

## **202 ROADWAY EXCAVATION**

### **202.01 DESCRIPTION**

This work shall consist of excavation for the roadways, alleys, parking areas, driveways, sidewalks, approaches, storm drain ditches, and stream channels to the lines and grades indicated in the contract documents. The work also includes the flattening and rounding of slopes, removal of slides, excavation for ditches and cutting of existing pavement and base to neat lines at the limits of proposed pavement construction.

It shall include excavating material in the sub grade (undercutting) and beneath embankment areas that are determined to be unsuitable by the Chief Engineer. The work shall also include the hauling and disposal of excavated material.

In the event that there is no item for Clearing and Grubbing included in the Schedule of Prices, all requirements of 201 shall be included as Excavation. All excavation will be classified as hereinafter described.

### **202.02 COMMON EXCAVATION**

Common Excavation shall consist of the excavation and removal of all materials encountered exclusive of Hard Surface Pavement Excavation per 202.03, Structure Excavation or excavation that is otherwise classified and paid for. When the contract documents include other classified excavation items, they shall be used as specified and paid for separately.

Common Excavation shall include undercutting to remove soft and/or unsuitable material that may be encountered in the sub grade or base course within the limits prescribed by the Chief Engineer. Also included is special or hand excavation, as necessary, over, around and under existing or new utility lines and appurtenances uncovered from such undercutting. The replacement material shall be furnished, placed and compacted as per Aggregate Base Course.

In the event that there is no item for Hard Surface Pavement Excavation included in the Schedule of Prices, all materials described in 202.03 shall be classified as Common Excavation.

Material from the excavation that meets the requirements of 203 may be used as specified therein.

### **202.03 HARD SURFACE PAVEMENT EXCAVATION**

Hard Surface Pavement Excavation shall include the removal and disposal of all asphalt surface and binder courses from concrete base; the removal of bituminous pavement complete, including concrete, asphalt block, asphaltic concrete or cobble bases; all stone curbing and concrete curb and gutter; all plain and reinforced cement concrete pavements and bases, driveways, alleys, concrete copings, steps; concrete, brick and stone walls; concrete, brick, and asphalt block sidewalks not in replacement and/or repair areas; and any abandoned utilities encountered in the limits of the work, and similar materials. Where the construction of new roadways and/or sidewalks meet existing roadways and/or sidewalks, this item shall include trimming the existing roadways and/or sidewalks to a neat, clean, vertical face, and the top

surface for a minimum depth of 1 ½ inches shall be trimmed to a neat line with a power saw where practicable.

When asphalt surface and binder courses are separately removed from existing concrete bases, this removal shall be designated as Pavement Profiling (Milling) as per Section 606.

The removal of bituminous (penetration) macadam, water-bound macadam, and old material roadway when removed and disposed of separately from base course shall be designated as Pavement Profiling (Milling) as per Section 606 and shall include the disposal of all surplus material.

The removal of scaled and deteriorated Portland Cement Concrete and/or asphaltic concrete from existing pavements to the depth specified or as directed by the Engineer shall be designated as Pavement Profiling (Milling) as per 606 and shall include the disposal of all surplus material.

#### **202.04 CONSTRUCTION REQUIREMENTS**

The Contractor shall notify the Chief Engineer a sufficient length of time in advance of its intent to begin any excavation. The Contractor, as part of the field layout, shall prepare all cross-sections, elevations and measurements of the undisturbed ground needed to compute excavated quantities. Elevations shall be taken prior to the beginning of any roadway excavation. Quantities for excavation shall be computed using the average end area method and shall be provided to the Chief Engineer before payment for excavation will be made.

Excavation shall be cut accurately to grade and cross-section as required, within the limits designated. All earth slopes shall be finished to neat lines, with toe and top of slopes appropriately rounded. Work shall be done in proper sequence with all other operations involved.

Prior to the removal of existing roadways, paving, sidewalks, curbs, gutters and wheelchair ramps, the portion to be removed shall be saw cut for the full depth thereof as shown in the contract documents or as directed by the Engineer and shall include any base courses. The Contractor shall use tools, equipment, and methods that shall be approved by the Chief Engineer for cutting, breaking and trimming and the removal of materials shall be to a neat, clean line, with minimum damage to adjacent pavement, sidewalk and curbs that are to remain. Any excessive damage done at these locations shall be repaired and restored by the Contractor at no cost to the District.

In replacing existing pavements, the Contractor shall saw cut all pavement within 1 foot of the walls or roofs of public or District utility structures. Proper care shall be taken by the Contractor to protect these structures against damage and to maintain them in good condition.

All rocks, abandoned walls or piers and similar structures encountered within the area of the roadbed shall be removed to a depth of at least 1 foot below sub grade and backfilled with suitable material.

Excavated areas shall be properly drained at all times. Roadbed soil that is softened by water shall be corrected to the satisfaction of the Chief Engineer at the expense of the Contractor.

The use of explosives shall be by permit and only under conditions as directed by the Chief Engineer. When pre-splitting of rock slopes is specified in the contract documents, the pre-

splitting operation shall be carried out in such a manner as to produce a uniform plane of rupture in the rock to prevent subsequent blasting and excavation operations within the section affecting the back slope face. The initial pre-split shot shall not be longer than 100 feet and shall be used to establish the spacing of drill holes and the proper blasting charge to be used in the pre-splitting operation. The initial pre-split shot shall be excavated for inspection by the Chief Engineer prior to further pre-splitting operations. If the Chief Engineer approves the results, the pre-splitting may continue using the approved drilling and loading pattern. If the pre-splitting is found to be unsatisfactory, the Contractor shall make adjustments in the operation and repeat the inspection procedure used for the initial pre-split shot.

The pre-split holes shall be drilled on maximum 3-foot centers and to a maximum depth of 20 feet unless otherwise directed by the Chief Engineer. If the vertical depth to the plan grade is greater than 20 feet, the blasting shall be done in two or more lifts and the drill holes shall be set back a sufficient distance from the slope line to allow for a 1 foot offset for each succeeding line of drill holes.

No excavation shall be deposited or stockpiled at any time so as to endanger portions of the new or an existing structure, either by direct pressure or indirectly by overloading banks contiguous to the operation. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of the construction or future work by others as determined by the Chief Engineer. If there is not sufficient area available for stockpiling within the limits of the project, the Contractor will be required to furnish its own area for stockpiling.

All excess and unsuitable material shall be removed from the limits of the work and be disposed of by the Contractor. The Contractor will be required to furnish its own disposal area.

#### **202.05 MEASURE AND PAYMENT**

The unit of measure for the various classes of Roadway Excavation will be the cubic yard. The number of cubic yards will be computed by the average end area method; however, at locations where end area measurements cannot be taken that will produce the requisite accuracy. The Chief Engineer may substitute other methods to determine the correct quantities.

Cross sections will be taken of the undisturbed ground. Any materials removed or excavated before these measurements have been taken will not be included in the number of cubic yards measured. Unless it is ordered by the Chief Engineer, material excavated below specified elevations will not be measured. If so ordered, such additional cross-sections as are necessary will be taken.

Any excavation beyond specified limits will not be measured.

The cross-sectional area measured shall not include water or other liquid, but shall include mud, muck or similar semisolid material that has not been disturbed by the Contractor and that cannot be drained away.

The number of cubic yards of Roadway Excavation removed will be paid for at the contract unit price per cubic yard, which payment will include the excavation of all material, all grading, draining cut areas, undercutting soft and unstable areas in the roadbed and/or embankment, the removal and disposal of all material, and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein. Pre-splitting will not be measured but the cost will be incidental to the cost of excavation.

## 203 SOILS CONSTRUCTION – GENERAL

### 203.01 DESCRIPTION

These specifications include general requirements that are applicable to all types of soils construction. The work shall consist of the formation of embankments, roadbeds and backfilling of trenches, structures, etc., to the lines, grades and cross sections specified including trimming and finishing.

Payment for work required by this section shall be under the various pay items in these specifications.

Terms used in these specifications for the construction of soils foundations are in accordance with AASHTO M 146.

### 203.02 MATERIALS

Materials for earthwork shall meet the following requirements:

- Soils for embankments - 804.02
- Soils for trench backfill - 804.05
- Soils for base courses and structural backfill - 804.04
- Geotextile Fabrics and Membranes – 213

### 203.03 CONSTRUCTION REQUIREMENTS

#### (A) DENSITY AND MOISTURE REQUIREMENTS.

- (1) **DENSITY REQUIREMENTS.** The Standard Density requirements for soils and aggregate base courses and recycled materials shall be defined as the Maximum Dry (Laboratory) Density obtained by AASHTO T 180, Method D.

The in-place or required density shall be determined in accordance with AASHTO T 191 or AASHTO T310, and is expressed as a percentage of the Standard Density. If the in-place density sample contains material larger than 3/4 inch, the field density shall be adjusted for the material retained on the 3/4 inch sieve before direct comparison with the Standard Density.

The minimum in-place density shall be as specified in Table 203.03, Density Requirements.

- (2) **MOISTURE REQUIREMENTS.** Soils materials used in construction shall have a uniform moisture content suitable for compaction to the specified density. When necessary, the Chief Engineer may direct that the soil be moistened or dried to obtain suitable uniform moisture content.

If the materials are of such nature that heaving, pumping, rutting, or shearing occurs in the compacted soil under the action of the construction equipment, even though the density of the soil satisfies the above requirements, the moisture content of the soil will be considered unsatisfactory and shall be adjusted such that no heaving, pumping, rutting or shearing occurs in the compacted soils under the action of the construction equipment.

- (B) PROOF ROLLING OF IN-SITU MATERIAL.** Prior to placing any base course material and after the in-situ material has been properly compacted and fine graded to the correct elevation, the sub-grade shall be checked under the action of a loaded tandem or 10-wheeled dump truck or similar equipment. If soft spots are detected, or pumping, rutting or heaving occurs at the sub-grade, the roadbed shall be considered unsatisfactory and the soil in these areas shall be replaced to the depth indicated by the Chief Engineer. Materials used to replace unsatisfactory soil material in the sub-grade shall meet the requirements of 804.04 and 213. The improved sub-grade shall then be compacted to the density specified in Table 203.03 and fine graded to the correct elevation.

Upon satisfactory completion of the sub-grade layer, the base course layer shall be placed meeting the requirements of 209.06, properly compacted and fine graded to the correct elevation as shown the contract documents.

Where shallow utilities or similar construction conditions prohibit proof rolling or correction by replacement and the soils foundation is not suitable for hauling over directly, the Contractor shall provide approved means for protecting the soils foundation against damage caused by equipment moving over it. If an approved means is used for protecting the soils foundation around shallow utilities or similar construction against damage caused by equipment moving over it, the unsatisfactory soil in these areas shall be replaced, as directed by the Chief Engineer, to a depth below the utilities or similar construction by material meeting the requirements of 804.04 and 213 and compacted to the density specified in Table 203.03.

- (C) FORMATION OF EMBANKMENTS.** All excavated material meeting the applicable requirements of 203.02 may be used in the formation of any embankment, or similar construction. All other materials shall be disposed of outside the limits of the project.

During the construction, the embankment shall be maintained in such condition that it will be well drained at all times, and the grade shall be shaped and rolled to drain when precipitation is imminent and at the end of each day.

After precipitation, all soft wet material on the grade shall be removed at the Contractor's expense before additional material is placed. No fill shall be placed in natural drainage ditches until necessary pipes or culverts have been installed.

No material used in embankments shall be placed in a loose lift thickness in excess of 6 inches. Each loose lift shall be compacted to the density requirements of Table 203.03 before another loose lift is placed. Frozen material shall not be used nor shall material be placed on frozen embankment foundation, embankment or base course.

Compacting equipment shall meet the requirements of 902. Any portion of the embankment or embankment foundation that is not accessible to the roller shall be compacted to the specified density by an approved mechanical tamper. Puddling or jetting is prohibited. The Chief Engineer may permit compaction with types of equipment other than those specified above, provided that the use of the alternate equipment will consistently produce requisite densities. The Chief Engineer's permission shall be in writing and shall set forth the conditions under which the equipment is to be used.

The Contractor shall be responsible for the stability of all constructed soils foundations and shall replace any portions that, in the opinion of the Chief Engineer, have become displaced or

disturbed due to careless or negligent work, or to damage resulting from any kind of storms and not attributable to the unavoidable movement of the natural underlying ground on which the constructed soils foundation rests. No pavement materials shall be placed on any base, roadbed or soils foundation until it has been approved by the Chief Engineer.

**TABLE 203.03 DENSITY REQUIREMENTS**

<b>DESCRIPTION</b>	<b>MINIMUM DENSITY REQUIRED, PERCENT OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T180 D</b>
Embankments, Trench Backfill and Borrow Trench Backfill	93 percent per each layer up to 6 inches below sub grade.
	95 percent for top 6 inch layer of sub grade.
	95 percent for full depth of embankments in confined areas where the use of clean sand is permitted.
Upper 6 inches of Roadbed (Top 6 inches of sub grade)	93 percent under curb, gutter, sidewalk, driveway entrances and alley entrances.
	95 percent under PCC roadway pavement areas.
	100 percent if full depth bituminous concrete pavement is used.
Existing and New Aggregate Base Courses, base, pavement or sidewalk.	95 percent for PCC
	100 percent for bituminous concrete pavement.
Structural Backfill	95 percent.
Backfill for undercut areas	95 percent
Backfill for undercut areas underneath footing and mat foundation	100 percent
Tree Space	85 percent

## **204 EMBANKMENT FILL**

### **204.01 DESCRIPTION**

This item shall consist of the construction of embankments to the lines, grades and cross sections shown in the contract documents or as directed by the Chief Engineer. Approved sources of material may include suitable excavated materials from the project location that meet specification requirements.

Approved fill materials excavated from the project location and incorporated into the finished work shall be known as Embankment Fill. Embankment materials obtained from other approved locations shall be known as Borrow Embankment Fill.

### **204.02 MATERIALS**

Material shall conform to 804.02.

### **204.03 CONSTRUCTION REQUIREMENTS**

Embankment fill shall be constructed and tested in accordance with 203 and the following:

Where embankments are to be made on, or merge with, a slope or an existing embankment having a slope steeper than three to one (3:1), the existing slope shall be cut in benches or steps as each lift is placed and to the depth directed by the Chief Engineer.

Where the thickness of the embankment to be placed is less than 2 feet, any existing hard surface pavement shall be removed and the area compacted as in-situ soil immediately following the excavation and prior to placing any fill material; any soft spots revealed by this compaction shall be removed and replaced to the depth indicated by the Chief Engineer. Where the thickness of the embankment to be placed is greater than 2 feet, any existing hard surface pavement shall be thoroughly scarified or broken prior to placing any fill material.

Areas that have been cleared and grubbed shall be compacted as in-situ soil before placing any embankment material; any soft spots revealed by this compaction shall be removed and replaced to the depth indicated by the Chief Engineer.

### **204.04 MEASURE AND PAYMENT**

The unit of measure for Embankment Fill or Borrow Embankment Fill will be the cubic yard. The number of cubic yards will be computed by the average end area method; however, the Chief Engineer may substitute other methods to determine the requisite quantities.

The actual number of cubic yards of Embankment Fill or Borrow Embankment Fill as determined will be paid for at the contract unit price per cubic yard, which payment will include labor, materials, tools, equipment, and incidentals necessary to complete the work as specified herein, including furnishing, stockpiling, hauling and compaction.

## 205 STRUCTURE EXCAVATION AND DEMOLITION

### 205.01 STRUCTURE EXCAVATION

- (A) **GENERAL.** Structure Excavation shall consist of excavation for the foundations of structures below the natural ground line and/or below the elevation of the finished roadway or roadways and appurtenances, railroad roadbed and stream channels, as shown in the contract documents.

Structure Excavation shall be excavation as shown and specified in the contract documents and/or standard drawings, including portions of existing structures encountered.

Excavation shall include removal of all materials and objects, of whatever nature encountered in excavation; disposal of excavated materials as specified herein: the construction and maintenance and subsequent removal of cribbing, sheeting, shoring and bracing; all necessary bailing, draining and pumping; and all precautions and work necessary to prevent damage to adjacent properties resulting from this excavation.

Material from the excavation that meets the requirements of 203 may be used as specified therein.

The elevations of the bottom of footings, as shown in the contract documents, shall be considered as approximate only and the Chief Engineer may order in writing such changes in elevations of footings as may be necessary to secure a satisfactory foundation. Payment for additional depth will be made in accordance with 205.05.

### (B) CONSTRUCTION REQUIREMENTS

- (1) **General** - The Contractor shall notify the Chief Engineer a sufficient length of time in advance of the beginning of any excavation, so that cross sections may be taken of the undisturbed ground.

The Contractor shall submit, in accordance with 105.02, drawings showing his proposed method of sheeting, bracing and shoring construction and other pertinent features not shown in detail in the contract documents. Such drawings and features shall be approved by the Chief Engineer before construction is started, but this approval shall not relieve the Contractor of any of its responsibility for constructing and maintaining this construction. The determination of sheet piling lengths shall be the sole responsibility of the Contractor.

All excavation adjacent to existing pavements and structures shall be sheeted, shored, braced and supported in a substantial manner to prevent settlement, movement or damage to the existing pavement or structure.

The Contractor, at his own expense, so as to provide necessary clearances and dimensions, shall correct any movement or bulging of shoring that occurs

After each excavation is completed, the Contractor shall notify the Chief Engineer, and no foundation piles shall be driven or concrete placed until after the Chief Engineer has given his approval.

Material forced above the plan elevation of the bottom of the foundation or tremie seal by the pile driving shall be removed at the Contractor's expense.

The use of explosives shall be by permit and under conditions as directed by the Chief Engineer.

All sheeting, shoring, and bracing involved shall be removed by the Contractor after the completion of the permanent structure, in a manner so as not to disturb or mar the structure. Sheeting may be left in place only by written permission from the Chief Engineer, subject to such conditions as the Chief Engineer may require. No payment will be made by the District for such sheeting, shoring and bracing so left in place.

No excavated material shall be deposited at any time so as to endanger portions of the new or an adjacent structure, either by direct pressure or indirectly by overloading banks contiguous to the operation, or in any other manner. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of the construction or future work by others as determined by the Chief Engineer. If there is not sufficient area available for stockpiling within the limits of the project, the Contractor will be required to furnish his own area for stockpiling.

All material shall be removed from the limits of the work and be disposed of by the Contractor. The Contractor will be required to furnish his own disposal area.

- (2) **Preparation of Foundations.** It is intended that all footings shall be constructed in open excavations, where practicable, and that all such excavations shall be completely dewatered and kept dewatered for the placing of all concrete and backfill. Elevations for the bottom of the footings shown on the contract documents shall be considered approximate only. The Chief Engineer may, during construction, direct changes in dimensions or elevations of footings to achieve a satisfactory foundation.

All rock or other hard foundation material shall be free of all loose material, cleaned and cut to a firm surface, either level, stepped, or roughened, as may be directed by the Chief Engineer. All seams shall be cleaned out and filled with concrete, mortar, or grout.

When masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation and the final removal of the foundation material to grade shall not be made until just before the masonry is to be placed. If in the event the foundation becomes wet and spongy or otherwise unsatisfactory prior to the placing of concrete thereon, the Contractor shall, at no additional cost to the District, remove the unsuitable material and replace it with suitable material to secure an adequate foundation, as determined by the Chief Engineer.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping will be permitted during the placing of concrete or for a period of at least 24 hours thereafter, unless done from a suitable sump separated from the concrete work by a watertight wall or by means of well points.

Faces of footings shall be placed plumb against undisturbed material, rock, sheeting, shoring or forms. Faces of footings in rock shall bear against a minimum 1 ft depth

of rock. If the excavation will not stand plumb, the Contractor shall furnish and install sheeting, shoring or forms as required.

- (3) **Cofferdams.** In the event that the construction of the foundation requires underwater construction, the Contractor shall submit drawings for approval, in accordance with 105.02, showing his proposed method of cofferdam construction and other pertinent features. Cofferdams shall be constructed so as to protect green concrete against damage from sudden rising of the stream or river. Bracing shall not extend into the substructure masonry.

The areas included within cofferdam construction shall be such that forms can be placed inside the sheeting for the sides of the concrete footings and so that any leakage into the enclosed area may be conducted to pumps outside of the footing forms. Cofferdams shall be of such dimensions that there will be no reduction in the net size of concrete base or tremie seal course shown in the contract documents and also to insure that, with the pile driving equipment proposed for use, all piles can be driven in their correct position with the batter specified. Should any sheet piles or other walls of cofferdams encroach upon the net minimum dimensions of tremie seal course shown in the contract documents, the cofferdams shall be reconstructed as necessary to clear the minimum lines. Sheet piles, if used, shall be driven sufficiently below the bottom of excavation and of concrete to provide adequate lateral support for the piles and to allow excavation to the full depth required. The effect of such penetration on the position of battered piles shall be provided for in the cofferdam design. In no case shall horizontal wales extend more than 12 inches inside the net concrete dimensions of the seal courses as shown in the contract documents.

Any pumping from the interior of the foundation enclosure that may be permitted shall be done in such a manner as to preclude the possibility of any portion of the concrete materials being carried away. No pumping will be permitted during the placing of concrete, or for a period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete by a watertight wall. Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressures.

Removal of sheeting, shoring, and bracing shall be as specified in 205.01(A), except that, at the Contractor's option, all parts of cofferdams and similar temporary construction below the level of top of concrete tremie seal course may be allowed to remain in place, but no payment will be made for such sheeting, shoring, or bracing so left in place.

Unless permitted by the Chief Engineer, no excavation shall be made outside of the cofferdam. If any excavation or dredging is made at the site of the structure before caissons, cribs, or cofferdams are sunk or are in place, the Contractor shall, at no additional cost to the District, after the foundation base is in place, backfill all such excavation to the original ground surface or riverbed with material satisfactory to the Chief Engineer. Material deposited within the stream area from foundation or other excavation or from the filling of cofferdams shall be removed and the stream area freed from obstruction thereby.

**205.02 DEMOLITION**

- (A) **GENERAL.** Demolition shall consist of complete or partial removal and disposal of various materials from existing structures as shown and specified in the contract documents.
- (B) **CONSTRUCTION METHODS.** All items designated to be wholly or partially removed shall conform to the contract plans and specifications, unless otherwise approved by the Chief Engineer. Any material removed beyond authorized limits, or any portion of remaining structure damaged as a result of negligence on the part of the Contractor, shall be replaced or repaired by the Contractor at his own expense. Before cutting or disconnecting members the Contractor shall assure himself that members are adequately supported. The Contractor shall also construct and maintain protection shields about the trees in the vicinity of the work to prevent inadvertent damage during the length of the project. The use of explosives and blasting procedures is prohibited, unless specifically granted by permit.

Prior to partial concrete removal, the perimeter of the area to be removed shall be carefully saw cut to a neat line. The cut lines shall be made down to the outside layer of reinforcing steel making sure that bars to be retained are not damaged. No debris shall be deposited, dropped, placed or secreted within the waters or land beneath or adjacent to the structure. Material shall be removed daily and not allowed to accumulate on or adjacent to the project site.

- (1) **Protection Shield** - Prior to any removal, a protection shield, meeting the requirements of 626, shall be properly installed in the work zone area. The shield shall remain in place until all construction activity related to the appropriate phase is completed.
- (2) **Support of Existing Structural Elements** - Particular care shall be exercised in all operations to prevent collapse or damage to portions of the structure which are to remain or reused. The Contractor shall assure the Chief Engineer that all structural elements are adequately supported before disconnecting or removing them.

Prior to removal of any structural elements, the Contractor shall design adequate temporary supports in accordance with 703.16, False work and Centering. Working drawings with calculations prepared and stamped by a Registered Professional Engineer shall be submitted to and approved by the Chief Engineer showing all temporary supports prior to beginning work.

- (3) **Reinforcing Steel** - Existing reinforcing steel to be retained for splicing with new steel shall be cleaned, straightened or bent as required and cut to the desired length. New steel shall be spliced to existing steel as per AASHTO requirements.

When existing reinforcing steel to be retained is damaged during demolition, the Contractor shall, at his own expense, substitute a bar of equal size drilled in and grouted to the required lap as per AASHTO requirements.

Where projecting bars are not to extend into the new construction, they shall be cut off flush with the surface to which the concrete has been removed. Cleaning reinforcing steel and removal of excessive length of bars shall be included as part of this work. All material removed shall be disposed of outside the construction area.

**205.03 STRUCTURE HARD SURFACE EXCAVATION**

- (A) **GENERAL.** This work shall consist of removal and disposal of concrete from existing structures such as retaining walls, median barriers and concrete islands to the limits as specified in the contract documents. Included in this work is saw cutting to a neat line the perimeter of the area to be removed and carefully removing the material to the indicated depth so as not to damage electrical conduits and reinforcing steel to remain in place. Also included is cleaning, bending or straightening as required and cutting existing reinforcing steel to remain in place as shown on the contract plans and as directed by the Chief Engineer.
- (B) **CONSTRUCTION REQUIREMENTS.** Prior to the removal of any concrete, the perimeter of the area to be removed shall be carefully saw cut to a neat line. The cut shall be sufficiently shallow to avoid damaging the existing reinforcing steel to remain in place. Concrete shall be carefully removed so as not to damage the structure to remain. Restrictions may be placed in the contract specifications on the type and size of demolition equipment to be used.

Concrete shall not be removed beyond the specified limits without the approval of the Engineer. Concrete that is removed or damaged by the Contractor beyond the limits of removal shall be saw cut, removed and replaced at the Contractor's expense.

Existing Reinforcing Steel - Existing reinforcing steel to be retained for splicing with new steel shall be cleaned, straightened or bent as required and cut to the desired length. When existing reinforcing steel to be retained is damaged during removal of concrete, the Contractor shall, at his own expense, substitute a bar of equal size drilled in and grouted in the existing concrete to achieve the required 30 bar diameters or spliced length as specified on the plans.

In areas where the required length for splicing cannot be achieved, the Contractor shall use a mechanical bar splice, equal to 125% of the strength of the bars, to connect the new bar to the existing bar. Welding of reinforcing steel shall not be permitted.

Where projecting bars are not to extend into the new construction, they shall be cut off flush with the surface of the existing concrete.

**205.04 MEASURE**

- (A) **STRUCTURE EXCAVATION.** The unit of measure for Structure Excavation will be the cubic yard. The number of cubic yards will be computed by the average end area method. However, at locations where end area measurements cannot be taken which will produce the requisite accuracy the Engineer may substitute other methods to determine the correct quantities.

Cross sections will be taken of the undisturbed ground. Any materials removed or excavated before these measurements have been taken will not be included in the number of cubic yards measured. Trenches or foundation pits for structures or structure footings shall be excavated to the elevations shown, and any material excavated below that elevation, unless ordered in writing by the Chief Engineer, will not be measured.

Excavations will be computed from the actual dimensions of the excavated area limited by vertical planes 18 inches outside of and parallel to the footings and a horizontal plane at the bottom of footings or tremie seals to limits as shown in the contract documents.

- (B) **STRUCTURE HARD SURFACE EXCAVATION.** The unit of measure will be the cubic yard.
- (C) **COFFERDAM.** The unit of measure for Cofferdam will be the job. No direct measure will be made.
- (D) **DEMOLITION.** The unit of measure for Demolition will be the job. No direct measure will be made.

#### 205.05 PAYMENT

- (A) **STRUCTURE EXCAVATION.** The number of cubic yards of Structure Excavation, as measured, will be paid for at the contract unit price per cubic yard, which payment will include the excavation, removal and disposal of all material, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

When it is necessary, in the opinion of the Chief Engineer, to carry the excavation below the elevations shown on the plans, the excavation for the additional depth will be paid for as follows:

The first 3 feet below plan elevation will be paid for at the contract unit price. From 3 to and including 6 feet below plan elevation will be paid for at 125 percent of the contract unit price. From 6 to and including 9 feet below plan elevation will be paid for at 150 percent of the contract unit price. Excavation in excess of 9 feet below plan elevation will be paid for as extra work subject to the provisions of the contract.

- (B) **STRUCTURE HARD SURFACE EXCAVATION.** Payment for Structure Hard Surface Excavation will be made at the contract unit price per cubic yard, which payment will include saw cutting the perimeter to a neat line, removal and disposal of all materials, cleaning, bending and cutting of reinforcing steel to remain and all labor, tools, equipment and incidentals needed to complete the specified work.
- (C) **COFFERDAM.** Payment for Cofferdam will be made at the contract lump sum price, which payment will include furnishing all materials, construction of the cofferdam, underwater cleaning, dewatering, required treatment of effluent and sediments, maintenance of the cofferdam during construction, removal and disposal of all materials and all labor, tools, equipment and incidentals necessary to complete the work.
- (D) **DEMOLITION.** Payment for Demolition will be made at the contract lump sum price, which payment will include preparation of required working drawings, furnishing all materials, installing and disposing of temporary supports, removal and disposal of all materials, saw cutting the perimeter to a neat line, and furnishing all labor, tools, equipment and incidentals needed to complete the specified work.

## 206 STRUCTURE BACKFILL

### 206.01 DESCRIPTION

The work shall consist of the backfill of abutments, piers, walls, and culverts to the lines, grades and cross sections shown on the plans or as directed by the Chief Engineer. This shall include any additional area outside the excavation pay limits for construction of the structures. It shall be limited to the area between the bottom of the footing and the original ground or sub-grade, whichever is lower. Fill may be obtained from excavated material meeting specification requirements or from any approved source. Fill obtained from sources outside the project limits shall be designated as Borrow Structure Backfill.

### 206.02 MATERIALS

Materials shall conform to the requirements of 804.04.

### 206.03 CONSTRUCTION REQUIREMENTS

Structure Backfill or Borrow Structure Backfill shall be constructed in accordance with the requirements of 203 and the following:

The minimum in place density of structure backfill shall be 95 percent.

Where backfill is to be placed on both sides of abutments, piers, walls and culverts, the fill shall be placed and compacted on both sides to approximately the same elevation at the same time.

As soon as practicable, all excavated or open spaces resulting from the excavation shall be backfilled. Areas adjacent to footings shall be backfilled and compacted to the top of the footings within 48 hours after placing footing concrete.

Jetting or puddling of backfill will not be permitted.

Where sheeting, bracing, and supporting of any type has been used in constructing the structure, it shall be so removed that no voids are left in space occupied by it.

Backfill behind abutments, piers, and walls of structures will not be permitted until the concrete in the structures has aged for 14 days, except that backfill may be placed earlier if results of tests show that the concrete has obtained 85 per cent of the design strength and the concrete in the structure is at least 7 days old.

Structure backfill shall be placed in uniform horizontal layers of not more than 6 inches in loose depth and for the full width of the fill.

Heavy compaction equipment will not be permitted to operate closer than 4 feet from the structure, unless permitted by the Chief Engineer and in accordance with his direction. Special care shall be taken to prevent any wedging action against the structure and the existing slopes shall be stepped or serrated as necessary to prevent such wedge action.

Backfill within 4 feet of the structure shall be compacted by means of mechanical tampers. The tamped fill shall be brought up in conjunction with the layers in the adjacent fill.

Any damp-proofed surface or membrane waterproofing damaged by the placing of backfill shall be repaired by the Contractor at his expense.

**206.04 MEASURE AND PAYMENT**

The unit of measure for Structure Backfill or Borrow Structure Backfill will be the cubic yard limited by vertical planes 18 inches outside of and parallel to the footings and from a horizontal plane at the bottom of footings to the existing or finished grade and/or proposed sub-grade exclusive of the volume occupied by the structure and previous backfill.

The number of cubic yards of Structure Backfill or Borrow Structure Backfill will be paid for at the contract price per cubic yard whether on-site or borrow material is used. Payment will include all labor, material, equipment, and incidentals necessary to complete the work, including stockpiling, furnishing, hauling, placement and compaction.

## 207 TRENCH EXCAVATION AND BACKFILL

### 207.01 DESCRIPTION

Work consists of excavation, shoring, supporting utilities and backfilling as required in open trenches to specified widths and depths for the construction of sewers and water mains and their connections. It shall also include disposal of unsuitable and excess materials.

### 207.02 TRENCH SHORING

The Contractor shall furnish, place, maintain and remove such sheeting, bracing and other supporting material required to properly support trench side walls and side walls of cuts. The Contractor shall prevent the movement of any supporting material that might in any way injure persons or negatively impact the project other structures near the project, or reduce trench dimensions below those needed for proper construction.

Where excavation depth exceeds five (5) feet, adequate shoring is required. For deep trench cuts, adequate trench shields, braced or un-braced sheeting may be necessary.

Working drawings for the proposed method for trench support, maintenance and shoring removal shall be prepared under the direction, and bear the seal, of a Registered Professional Engineer with a valid P.E. license. Working drawing submittals will be for information only and shall be submitted in advance of work. The Engineer shall be notified in advance of any change in method of trench support and maintenance.

If the Contractor elects to use sheeting, the sheeting shall be removed in conjunction with trench backfilling; however, if approved in writing, sheeting may be cut off and left in place below a line one foot above the top of the pipe.

Voids that may develop outside the sheeting, shoring and bracing shall be promptly filled with appropriate material such as gravel, sand or other approved material. If at any point sufficient or proper supports have not been provided, the Chief Engineer may order additional supports to be installed at no cost to the District.

### 207.03 TRENCH EXCAVATION

Trench excavation shall include removal of all materials and objects of whatever nature encountered in excavation, excluding rock and existing steel sheeting left in place, unless otherwise directed by the Chief Engineer.

Sewer and water main trench operations shall be coordinated with other utility work and scheduled to meet maintenance of traffic provisions.

Trench width for payment at all sewer and water main trench cross sections will be based on requirements of 207.05(A).

Surface materials of whatever nature shall be removed within trench limits unless otherwise directed by the Engineer.

Before excavating, cuts through existing hard surface roadways shall be made by saw cutting through the full depth of the hard surface along the trench limit line. The types of paving materials to be cut are indicated in the contract documents but are not guaranteed.

Trench repairs shall be made by saw cutting a six inch shoulder along the trench limit lines to 1/3 of the depth of the adjacent pavement, then using pneumatic tools as required to make even, neat edges. The trench shall be paved with 10 inch reinforced PCC Base or finished PCC pavement and topped with an asphalt surface as needed. Payment for trench repair shall be made using appropriate repair/replace items.

Use of impact type breakers for PCC and AC removal over trenches shall be restricted to the Hoe Ram type or approved equivalent. This equipment may be restricted or prohibited when in the public interest.

Operations shall be conducted so as to avoid injury to tree trunks, branches and roots. Excavations within limits of tree root spread shall proceed with care either by use of hand tools or with equipment that will not cause tree root damage. Exposed roots 2 inches and larger in diameter shall be wrapped in burlap or other approved material and kept moist at all times. Roots 2 inches and larger in diameter outside the actual space occupied by the sewer or structure shall not be cut; excavation shall be tunneled under these roots. When approved, tree branches that interfere with construction may be trimmed in advance of excavation. Root cutting and branch trimming shall be performed in accordance with accepted horticultural practice.

When excavating trench through lawn, park or other tillable areas, sod and topsoil shall be removed with care as directed and salvaged if suitable for reuse in restoring disturbed surfaces.

When approaching existing underground construction that may be in proximity to sewer grades, or approaching existing sewers or water mains for connections, the trench shall be opened a sufficient distance ahead of the work, test pits made per 212, or other approved exploratory methods employed to allow for authorized changes in line and grade. Changes in line and grade plus excavation and pipe removal caused by failure to take such precautions shall be made at the Contractor's expense.

The Contractor shall support all exposed underground pipes or conduits along their entire exposed length using timber or steel in such a manner that backfilling may be performed without dislodging such pipes or conduits. No additional payment will be made for support material left in place nor for installing and maintaining supports.

At the Contractor's option, the actual width of trench above the top of the pipe may exceed the permissible width below the top of the pipe if approved by the Engineer. No additional payment will be allowed for the additional excavation and backfill.

Utility service connections and appurtenances to individual premises may not be shown in the contract documents, and the Contractor shall determine the exact location of, and maintain, these services.

With prior approval, portions of trench excavation may be removed as tunnel at the contract price for Trench Excavation measured from the surface as if open cut. Tunnel bracing and all repair shall be included as part of work.

Tunnel excavation shall meet requirements of Safety Standards, "Rules and Regulations For Work In Tunnels And Work Under Compressed Air". In tunnel excavation, work includes backfilling the void between the sewer structure and the tunnel roof with PCC of approved mix design. If there is any sign of settlement or loose material in the tunnel roof or walls during

tunnel work, the excavation shall be made in open trench as directed. Tunneling will not be permitted when the outside of the tunnel roof is within 2 feet of the bottom of PCC or AC base.

The tunnel bottom shall be excavated approximately flat and square with trench walls. When material at trench grade is suitable, trench bottom shall be protected and maintained. Extra excavation and disposal, furnishing and placing undercut gravel to maintain trench bottom shall be at the Contractor's expense.

If material found at the bottom of the trench is unsuitable for a foundation for pipe bedding, it shall be removed by the Contractor as directed and replaced with gravel or crushed stone per 207.06(A). Payment will be per 207.06(B).

Except in downtown and other congested areas, trench excavation shall be completed at least 25 feet in advance of pipe-laying. At the end of a work day or at the discontinuance of work, the pipe laying shall be completed to within five (5) feet of the end of the open trench.

All suitable trench excavation material meeting requirements of 804.05 shall be stockpiled, protected and maintained. Excavated materials shall be neither deposited nor stockpiled so as to endanger new or existing structures or utilities, nor to interfere with the project construction sequence and work by others.

The Contractor shall remove and dispose of all excess and unsuitable materials and shall furnish its own disposal areas.

**(A) ABANDONED UTILITIES.** Work includes removal of abandoned utilities or utilities to be abandoned within limits of trench excavation. Open ends of abandoned utilities or utilities to be abandoned shall be bulk-headed by either 9 inch thick brick masonry in large size openings, 9 inch thick brick masonry or PCC of approved mix design in small size openings, or 9 inch thick PCC of approved mix design or cast iron plugs or caps in small diameter abandoned water mains.

All abandoned in-place sewers with a 36-inch or larger diameter shall be filled with suitable material prior to bulk-heading.

Water mains and water appurtenances shall be abandoned in place as directed. Frames and covers of manholes and valve casings to be abandoned shall be salvaged and returned to the WASA property yard. Abandoned manholes and water valve casings shall be backfilled to grade with approved trench fill. Abandoned fire hydrants including standpipe and boot shall be removed and delivered to the WASA property yard; hydrant lateral shall be plugged. Water mains to be salvaged shall be severed as directed with a smooth cut at a joint or at an intermediate point if approved.

Where water valve casings or manholes to be abandoned are isolated from trench excavation limits, they shall be abandoned in place as indicated above and payment made per 303 or 313 as applicable.

Breakage will not be permitted. 24 inch and larger diameter mains must be cut normally. Any loss of value resulting from damage to usable and surplus water main materials resulting from Contractor operations will be charged to the Contractor.

- (B) **DEWATERING.** Trench dewatering and drainage of all surface and ground water, including pumping and well points when needed, shall be included as part of trench excavation.
- (C) **TEMPORARY PLATING OVER TRENCHES.** To maintain traffic and safety, steel protection plates per 624 shall be used to temporarily bridge trench excavations as directed by the Chief Engineer. Plates shall be of a size and positioned to provide adequate bearing at plate edges and shall be securely anchored. Plates shall be of sufficient thickness to safely carry heavy traffic without detrimental deflection. Plate edges exposed to traffic shall be feathered with temporary asphalt mix.

Work includes surveillance and adjustment of plating over trenches that shall be provided by the Contractor during non-work hours, weekends and holidays.

Plating and asphalt around plates shall be removed when directed.

#### **207.04 TRENCH BACKFILL**

When pipes and connections are complete and approved, trenches shall be backfilled per 203. Suitable excavated materials meeting requirements of 804.05 and density and moisture per 203.03(A) and (B) shall be used as directed for trench backfill. Approved base materials shall be used in that portion of the trench projecting through soils base layers.

Each lift shall be compacted to density requirements herein before next lift is placed.

The minimum in place density of trench backfill shall be 93 percent for each layer up to 6 inches below sub grade and 95 percent for the top 6 inch layer of sub grade. In trenches outside of the roadbed areas, all layers shall be compacted to at least 93 percent of standard density. The use of "Hydra-Hammer" for compacting backfill in trenches is prohibited. Compaction by hand will be required where necessary.

Trench fill soils shall have a uniform moisture content suitable for compacting to specified density. If rutting, pumping, heaving or shearing occurs under action of compaction equipment even though soil meets density requirements, affected material shall be replaced to limits as directed.

Trench fill material shall be dumped outside the trench excavation and not end-dumped directly into trench. Fill shall be placed in uniform horizontal layers of not more than 6 inches loose depth and for full trench width. Any fill placed on frozen trench soils shall be removed at Contractor's expense.

Backfilling shall proceed without displacement of the grade and alignment of the pipeline. Settlement of backfill shall be considered evidence of improper workmanship or inclusion of unsuitable backfill materials, or both, and will require re-grading and realigning the pipeline and removing and re-compacting settled material at no cost to the District.

Puddling and jetting will not be permitted. All trench shoring and supports shall be so removed that trench cave-in and settlement are minimized and no voids remain. Voids caused or left by sheeting and shoring removal shall be backfilled with pervious fill or other approved material and compacted at Contractor's expense. All material displaced by slides, settlement and trench cave-in shall be removed and replaced with specified soils at the Contractor's expense.

The Chief Engineer may require trench backfilling over completed pipelines at any time if in his judgment such action is necessary. Extra compensation will not be allowed for such trench backfilling.

The Chief Engineer reserves the right to limit the amount of pipe laid in advance of backfilling, but in no case shall these amounts exceed 100 feet for sewer work and 50 feet for water main work.

### 207.05 MEASURE AND PAYMENT

The unit of measure for Trench Excavation and Backfill will be the cubic yard. Space occupied by abandoned utilities will not be deducted. Volumes will be computed from following dimensions:

- (A) **WIDTH.** The width for payment at all sewer trench cross sections will be based on DDOT standard drawings 314.01 and 314.04, or as shown on the contract drawings.

The width at all water main trench cross sections will be based on DDOT standard drawings 305.05, or as shown on the contract drawings.

The trench width may be less than, but shall not exceed, the trench pay width for the trench section from trench sub grade to a point one-foot above top of pipe.

At the Contractor's option, the actual trench width more than one foot above the top of the pipe may exceed trench pay width if conditions will permit and are approved by the Chief Engineer. No additional payment will be allowed for additional excavation, backfill and temporary paving or for support or additional support of underground pipes or conduits that may be required as a result of the Contractor exceeding trench pay width. Should the Contractor elect this option, the Chief Engineer shall be notified prior to work so that he/she may estimate the additional cost of permanent paving. Monies due the Contractor shall be retained to cover temporary and permanent paving repair beyond trench pay widths.

If the value of W on the DDOT standard drawings listed above is exceeded below a horizontal plane 1'-0" above top of pipe, the Contractor shall submit to the Chief Engineer pipe design reevaluation computations certified by a professional engineer to assure that the allowable load on the pipe will not be exceeded. Computations shall reflect any additional work required such as concrete bedding, concrete encasement of pipe, higher class of pipe or any other proposed work to solve the problem. The Contractor shall perform all necessary work at no extra cost to the District.

- (B) **DEPTH.** The depth at any cross section will be based on mean depth from surface where trench excavation started to outside bottom of the sewer cradle, water pipe or structure at that section.
- (C) **LENGTH.** The length will be based on the horizontal projection of the completed sewer or water main without deduction for manholes, valves and fittings. Other types of sewer structures will be deducted from length measure.

Payment for Trench Excavation and Backfill will be made at contract unit price per cubic yard, which payment will include disposal of excavated materials, shoring and all labor,

materials, tools, equipment and incidentals necessary to complete work specified. Payment will not be made for sheeting and shoring left in place at the Contractor's option.

When water service and/or building sewer connections are part of contract, payment for trench excavation and backfill for water service and/or building sewer connections will be made under 308 and/or 316.

### **207.06 TRENCH UNDERCUT EXCAVATION**

- (A) **GENERAL.** When material at trench grade is unsuitable, trench bottom shall be undercut to depth and width as directed by the Chief Engineer. Undercut volume shall be backfilled with gravel or crushed stone per 804.06, compacted with a vibratory compactor, protected and maintained. Work includes disposal of excavated material.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Trench Undercut Excavation will be the cubic yard, with volumes computed from approved undercut dimensions. Provisions of 202.05 apply.

The unit of measure for Gravel for Trench Undercut will be the cubic yard, with volumes computed from approved undercut dimensions.

Payment for Trench Undercut Excavation below three (3) feet of undercut Trench Excavation limits will be made at 125 percent of contract unit price per cubic yard for Trench Excavation. Payment for excavation exceeding 5 feet average depth will be negotiated.

Payment for Gravel for Trench Undercut shall be made at the contract unit price per cubic yard complete in place as measured above, which payment will include labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein, including furnishing, hauling and compaction.

### **207.07 BORROW TRENCH BACKFILL**

- (A) **GENERAL.** Trench excavation soils meeting requirements of 804.05 shall be used as trench fill, and shall be protected and maintained; furnishing approved borrow soils to replace approved trench excavation soils that become unsuitable shall be at the Contractor's expense.

When trench excavation soils fail to meet requirements of 804.05 or when the quantity of approved trench excavation soils is insufficient, approved borrow trench backfill per 804.05 shall be used and payment made under Borrow Trench Backfill.

Flowable fill meeting the requirements of 804.07 may be used for trench backfill if approved by the Engineer.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Borrow Trench Backfill will be the cubic yard. The number of cubic yards will be computed by the average end area method; however, the Chief Engineer may substitute other methods to determine the exact quantity. Measurement for Borrow Trench Backfill shall be limited to the trench pay width outlined in 207.05 although its use beyond these limits will be required to properly backfill the trench as excavated. The space occupied by the pipe and cradle will not be included in the measurement.

The actual number of cubic yards as determined above will be paid for at the contract unit price per cubic yard, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein including furnishing, hauling and compaction.

## **208 PERVIOUS FILL**

### **208.01 DESCRIPTION**

This item shall consist of furnishing all materials, labor, tools and equipment necessary to place the Pervious Fill at the locations shown in the contract documents and/or as specified herein.

### **208.02 MATERIALS**

Materials for this work shall conform to 805.02.

### **208.03 CONSTRUCTION REQUIREMENTS**

This work shall be carried on in conjunction with the placement and compaction of the adjacent fill. The Pervious Fill material shall be placed in contact with the back of the walls and abutments as shown in the contract documents. The fill shall be compacted in horizontal layers not more than 1 foot in depth, to a minimum of 100 percent of the dry unit weight as determined by AASHTO T 19.

The Pervious Fill shall be placed so as not to mix with the earth backfill. If a form is used between the pervious fill material and earth backfill, none of it shall remain in the completed fill. Any earth backfill removed to place the Pervious Fill will be at the sole expense of the Contractor.

### **208.04 MEASURE AND PAYMENT**

The unit of measure for Pervious Fill will be the cubic yard. The number of cubic yards will be the volume of Pervious Fill placed as determined from plan dimensions.

The number of cubic yards placed will be paid for at the contract unit price per cubic yard, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

## 209 AGGREGATE BASE COURSE

### 209.01 DESCRIPTION

This item shall consist of constructing a base course to the specified depth on a prepared foundation conforming to the lines, grades and cross sections shown in the contract documents.

### 209.02 MATERIALS

Materials shall conform to the requirements of one of the following:

Crushed Stone - 804.04(A)

Recycled Crushed Concrete - 804.04(B)

Note: Recycled Crushed Concrete shall not be used in areas where subsurface drainage problems exist in the roadbed; in areas where the roadbed soil is unstable; within undercut roadbed areas; over backfill in areas where unsuitable materials have been removed; or under full depth flexible pavements

Fly ash and other pozzolans, when used with lime in a mixture of soil, soil aggregate or aggregate, shall conform to the requirements of ASTM C 593.

### 209.03 CONSTRUCTION REQUIREMENTS

Aggregate base course shall be constructed and tested in accordance with Section 203.

Except as required in excavating and replacing soft spots, the ground shall not be plowed scarified, or disturbed below the base course layer

Proof rolling as defined in 203 is required.

### 209.04 PLACING

After the grade has been properly shaped and compacted, the aggregate material shall be evenly placed and spread to a uniform depth without segregation. If the required compacted depth of the base course exceeds 6 inches, the base shall be compacted in 2 or more layers of approximately equal thickness. The maximum compacted thickness shall be 6 inches.

### 209.05 MIXING

After the material has been placed, water shall be added if needed to provide the optimum moisture content and the material uniformly mixed by means of a motor grader or other approved equipment.

### 209.06 SHAPING AND COMPACTION

Upon satisfactory completion of the sub-grade layer as per 203.03 and placement and mixing, if necessary, of the aggregate base course layer, compaction and fine grading shall occur using approved rollers to achieve the correct elevation as shown on the Plans. Prior to the placement of any pavement section layer, the aggregate base course layer shall be proof rolled under the action of a loaded tandem or 10-wheeled dump truck or similar equipment. If any ruts or irregularities occur in base course layer, it shall be considered unsatisfactory and

replaced to the depth indicated by the Chief Engineer. Materials used to replace unsatisfactory base course material in shall meet the requirements of 804.04 and 213. The Contractor shall rework the aggregate base to the specified density, line, and grade. Tamping instead of rolling is prohibited.

Compaction shall continue until densities are obtained of not less than 95 percent under a rigid pavement and 100 percent under a bituminous pavement of maximum density determined in accordance with AASHTO T 180, Method D.

New base course for sidewalk foundations shall be compacted to a density of 95 percent. As directed by the Chief Engineer, any unsuitable materials shall be removed and replaced with materials meeting the requirements of 804.04.

### **209.07 MEASURE AND PAYMENT**

The unit of measure for Aggregate Base Course will be the cubic yard. The actual number of cubic yards of base course of variable dimensions, measured complete in place will be paid for the contract unit price per cubic yard, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein. Payment will also include all re-compaction and/or scarifying necessary to achieve the required density.

If the Chief Engineer determines any volume measurement to be inappropriate, a value of 3,800 pounds per cubic yard will be used to convert verified weights to a cubic yard basis.

## **210 RECOMPACT EXISTING BASE COURSE**

### **210.01 DESCRIPTION**

This work shall consist of reshaping and re-compacting the existing base course material. If the existing base course layer is found to be composed of soils base material, it shall be removed and reconstructed as per sections 202 and 209 after treatment of the new sub-grade layer as per 203.

### **210.02 MATERIALS**

In place base material used for this work shall comply with 804.04.

### **210.03 CONSTRUCTION REQUIREMENTS**

Construction methods and requirements shall conform to 203 and 209. After the existing pavement has been removed, including all AC and PCC chips exceeding 1 inch in diameter and all other foreign material, the existing base course shall be redistributed and re-compacted to the lines, grades, cross sections and densities required in the contract documents. Proof rolling, as defined in 209.06, will be required. Any existing base course material that is found to be unsuitable shall be removed and replaced in conformance with 209. Material that is found unsuitable because of contamination caused by the method of pavement excavation or because of precipitation after pavement excavation shall be removed and replaced at the Contractor's expense.

If the roadbed or other courses being prepared was constructed under the same contract, the work shall be performed at the expense of the Contractor without any direct compensation being made.

### **210.04 MEASURE AND PAYMENT**

The unit of measure for Re-compact Existing Base Course will be the square yard. The actual number of square yards of existing base course redistributed and compacted will be paid for at the contract unit price per square yard, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

The removal of existing unsuitable material will be paid for under the appropriate excavation item. Additional aggregate base material required to obtain the required line, grade and cross section or to replace excavated unsuitable material will be paid for under the appropriate base course item.

## **211 SCARIFYING**

### **211.01 DESCRIPTION**

Scarifying shall consist of plowing, scarifying or otherwise loosening the old gravel or macadam roadway to the depth specified or as directed by the Chief Engineer, redistributing the loosened material across the full width of the soils foundation and compacting to the density requirements for roadbed sub-grade and/or base course as appropriate. These three operations shall be accomplished in sequence without an appreciable time interval between each.

### **211.02 CONSTRUCTION REQUIREMENTS**

When scarification results in a loose depth of material in excess of 6 inches, re-compaction shall be accomplished in 2 or more lifts in accordance with the requirements of 203 and/or 209 for roadbed sub grade and/or base course as appropriate.

Proof rolling as specified in 203.03(B) or 209.06 will be required.

### **211.03 MEASURE AND PAYMENT**

The unit of measure for Scarifying will be the square yard. The actual number of square yards measured at the site prior to start of scarification will be paid for at the contract unit price per square yard, which payment will include the distribution of the loosened material throughout the full width of the soils foundation and compacting to the required density, and all labor, materials, tools, equipment, and incidentals necessary to complete the work as specified herein.

## 212 TEST PITS

### 212.01 DESCRIPTION

Work consists of excavation, backfill, compaction and restoration as required to excavate test pits necessary to locate or determine type and/or condition of materials of construction of underground utilities.

### 212.02 SUBMITTALS

Each test pit location and estimated size shall be submitted to the Chief Engineer for approval.

### 212.03 MATERIALS

Test Pit Excavated Material

Sodding-610.02

### 212.04 CONSTRUCTION REQUIREMENTS

When water service work is included in proposed sewer pipe construction projects, trench excavation under 207 will uncover those water service connections crossing the trench when the proposed sewer will run between the water main and the curb line. Test pits will be required to determine the condition and material of the water service connections for the opposite side of the street where the water main runs between the proposed sewer and opposite curb line.

Pit size shall be approximately 2 ft. x 4 ft. or as directed by the Chief Engineer.

Pit depth shall generally be 4 ft. minimum and approximately 5 ft. maximum unless otherwise directed by the Engineer.

Test pits shall be scheduled as directed so that pit backfilling can be completed within the workday.

Test pits shall generally be located within the tree space. Test pits shall be required on both sides of a water meter to identify water service line materials.

All sod, bushes, etc., shall be salvaged and reinstalled to restore area to acceptable condition. Where salvaged items will be inadequate for restoration, provide new sod and other features.

It may be necessary to hand excavate portions of test pits in order to protect utilities.

Excavated material shall be stored and used for backfill unless the excavated material is unsuitable. Borrow fill shall be used only if the quantity of suitable excavated material is insufficient, and shall be included as part of the work.

When the pit is outside of the roadway and sidewalk areas, backfill shall be thoroughly compacted in 12-inch layers with pneumatic tampers. When the test pit is within the roadway or sidewalk area, compaction shall be per 207.04.

**212.05 MEASURE AND PAYMENT**

The unit of measure for Test Pits will be each.

Payment for Test Pits will be made at the contract unit price per each, which payment will include hand excavation as needed, backfill including borrow fill as needed, restoration including asphalt, concrete and sod as needed, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

## **213 GEOSYNTHETIC STABILIZED SUBGRADE USING GRADED AGGREGATE BASE**

### **213.01 DESCRIPTION**

This work shall consist of furnishing and installing a layer of geotextile fabric membrane and a minimum of 12 in. of graded aggregate base at undercut areas in the roadbed between the backfill material and the underlying soils sub grade to bridge unstable material and minimize the use of undercutting. This item shall only be used when specified in the contract documents or as directed by the Chief Engineer. In extremely unstable areas, the Chief Engineer may increase the thickness of the graded aggregate base course material.

### **213.02 MATERIALS**

The geotextile fabric shall meet the requirements of the contract documents and AASHTO M 288 for Stabilization Applications and shall be listed in the National Transportation Product Evaluation Program (NTPEP) for geotextiles. The fabric shall be a woven fabric manufactured from fibers consisting of long chain synthetic polymers, composed of a minimum 95 percent by weight of polyolefins or polyesters. The fibers shall be formed into a stable network so that the filaments or yarns retain their dimensional stability relative to each other, including selvages. Geotextile fabrics manufactured with polyamide will not be allowed. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, be mildew and rot resistant and conform to the following minimal physical property requirements:

Grab Strength (ASTM D-4632)	300 lbs
Puncture Strength (ASTM D-4833)	110 lbs
Trapezoid Tear Strength (ASTM D-4533)	110 lbs
Permittivity (ASTM D-4491)	0.05 sec <sup>-1</sup>
Apparent Opening Size (ASTM D-4751)	.15 mm (minimum)
Elongation at Failure (ASTM D-1682)	15%
Ultraviolet stability (ASTM D-4355)	At 500 hours exposure, 50% strength retained

All values are based on minimum average roll values in the weakest principle direction.

Geotextile fabrics used for subsurface drainage, erosion control, sediment control or as a permeable separator shall meet the requirements of 822.09. Geotextile fabrics used for soils reinforcement shall be approved as part of special provisions for structural systems.

**(A) Seam And Overlap.** When geotextile fabrics are joined by sewing, the geotextile seam shall conform to the following:

- (1) The seams shall be either "J" or Butterfly type and shall utilize a lock stitch.
- (2) The seams shall conform to the tensile strength requirements for the geotextile when tested across the seam.
- (3) The durability of the thread for seaming shall be at least equal to the geotextile itself.

- (B) **Securing Pins or Staples.** Securing pins or staples shall have a minimum 10 inch length and shall be designed to securely hold the geotextile fabric in place during construction.

### 213.03 CONSTRUCTION REQUIREMENTS

- (A) **TEST STRIP.** In extremely unstable areas, the Chief Engineer may direct that a test strip be constructed to determine the thickness of aggregate base layer required to stabilize the area. The test strip shall be a minimum of 100 ft in length and at least one lane wide. The Chief Engineer will determine the depths of aggregate base to be used in the test strip. Based on the results of the test strip, the Chief Engineer will determine the thickness of the aggregate base to use in subsequent construction.
- (B) **GRADE PREPARATION.** When geo-synthetic stabilized subgrade using graded aggregate base is specified, the area where the geotextile is to be placed shall be cut to the depth shown on the contract documents or as directed by the Chief Engineer. The grade upon which the geotextile is to be placed shall be brought to the line, grade and cross section specified. The grade shall be as smooth as practical and free of debris. Construction traffic on the grade shall be minimized. When ruts are formed by construction traffic, they shall be removed by reshaping the affected area. The grade shall not be overworked and shall be approved by the Chief Engineer prior to placement of the geotextile. Adequate surface drainage shall be maintained in conformance with Section 203. The Chief Engineer may waive the compaction and moisture requirements for the underlying soil on which the geotextile is to be placed.
- (C) **GEOTEXTILE PLACEMENT.** Care should be taken in placing the geotextile so that it is not damaged during construction. Geotextile shall be placed on the prepared surface for the full width of the area to be treated. In areas where longitudinal under drain is to be placed, the geotextile shall be placed up to the edge of the proposed longitudinal under drain trench but shall not be placed where the trench is to be excavated. The geotextile shall be unrolled on the grade parallel to the base line without dragging it across the grade. Wrinkles and folds shall be removed from the geotextile by stretching and pinning. The geotextile shall be overlapped a minimum of 3 feet at roll edges and ends. Overlaps at the end of the roll shall be in the direction of aggregate placement with the roll being covered on top of the next roll. Roll ends and roll end overlaps shall be pinned a minimum of 5 ft on center. Roll edges and roll edge overlaps shall be pinned a minimum of 50 ft on center. Securing pins or staples shall have a minimum 10 inch length and shall be designed to securely hold the geosynthetic in place during construction.

For curves, the geotextile shall be folded or cut and overlapped in the direction of the turn. Folds in the geotextile shall be pinned a minimum of 5 ft on center. Damaged geotextile shall be repaired or replaced immediately as directed by the Chief Engineer at the Contractor's expense. Geotextile patches shall be overlapped a minimum of 3 ft into undamaged geotextile. Traffic, including construction equipment, is prohibited on the bare geotextile.

- (D) **GRADED AGGREGATE BASE PLACEMENT.** Placement of the graded aggregate base shall be in conformance with 209 with the following exceptions:
- (1) **Placement and Spreading.** Graded aggregate base shall be placed within three working days of geotextile placement. The graded aggregate base course shall be

placed with care so that the geotextile is not damaged or displaced and to ensure that the proper laps and splices are provided. The graded aggregate base shall be placed as a single lift in the thickness required to provide the specified compacted depth. The graded aggregate base shall be placed by end dumping and spreading. Construction shall be parallel to the base line. The turning of construction equipment on the graded aggregate base shall be kept to a minimum.

- (2) Density Requirements. Immediately after placement, the graded aggregate base material shall be compacted to the required density in accordance with Section 203.
- (3) Vibration. Graded aggregate base shall not be vibrated unless otherwise specified or directed by the Engineer.

#### **213.04 MEASURE AND PAYMENT**

Geosynthetic stabilized sub grade or base using graded aggregate base will be measured and paid for at the Contract unit price per cubic yard. The payment will be full compensation for furnishing and placing the geotextile and graded aggregate base, compaction, test strip, and for all material, labor, equipment, tools and incidentals necessary to complete the work. Excavation will be measured and paid for in conformance with Section 201.

## 214 PERMEABLE BASE

### 214.01 DESCRIPTION

This work shall consist of constructing a permeable asphalt base or permeable concrete base on a prepared sub grade in accordance with these specifications and in conformity with the lines, grades, thicknesses and typical sections shown in the contract plans or as directed by the Chief Engineer.

The permeable asphalt base shall consist of a mixture of aggregate, polymer modified asphalt cement and approved anti-strip additive. The permeable concrete base shall consist of a mixture of aggregate, Portland Cement, admixtures and water.

### 214.02 MATERIALS

- (A) **AGGREGATES.** The aggregates for both the permeable asphalt base and the permeable concrete base shall be 100 percent crushed stone per ASTM C 33, Grading Size No. 57.
- (B) **ASPHALT.** The asphalt for asphalt treated permeable base shall be an approved polymer modified asphalt cement complying with 802.09. The percentage of asphalt cement shall be 2.0 percent to 4.0 percent by weight (mass) of the total mixture. Asphalt cement content and mixing process shall be such that all aggregates are visibly coated. Qualification samples shall be tested and the mixture shall retain a minimum of 90 percent coating when tested in accordance with an approved stripping test and anti-strip additive.

A job mix formula shall be submitted and approved in accordance with Section 400.

- (C) **ANTI-STRIP ADDITIVE.** The anti-strip additive shall be added at the minimum rate of 0.5 percent by weight of asphalt cement and shall be thoroughly mixed with the asphalt cement at the plant. Additional anti-strip additive may be added up to 1.2 percent by weight (mass).

The proposed job mix formula shall indicate a single anti-strip additive rate that is 0.1 percent greater than the percentage that will yield a minimum of 90 percent coating when tested. The approved range shall be 0.2 percent by weight (mass) of asphalt, with the lower limit being the quantity determined during testing and the maximum limit not to exceed 1.2 percent by weight (mass) of asphalt.

- (D) **PERMEABLE PORTLAND CEMENT CONCRETE.** Cement for permeable concrete base shall be a Type I or Type I(B) Portland Cement complying with Section 500.

Permeable concrete base shall have a minimum cement content of 235 pounds of Portland Cement per cubic yard (140 kg/cu m) of concrete. The water cement ratio of the mixture shall be not more than 0.37.

- (E) **ADMIXTURES.** Admixtures for the permeable concrete base shall comply with 814. The rate shall be as approved by the Engineer.

### 214.03 CONSTRUCTION REQUIREMENTS

- (A) **PERMEABLE ASPHALT BASE.** The permeable asphalt base shall be placed in accordance with Section 400. Compaction shall be with one to three passes of a 5 to 10 ton smooth steel wheel roller conforming to Section 902. Permeable asphalt base shall be placed at a temperature between 200°F to 260°F (90°C to 125°C) when measured in the hopper of the paving machine. Compaction shall begin when the temperature of the permeable asphalt base has cooled to approximately 160°F (70°C) and shall be completed before the temperature falls below 100°F (35°C).
- (B) **PERMEABLE CONCRETE BASE.** The permeable concrete base shall be placed in accordance with Section 501 or by an asphaltic concrete paver in accordance with Section 902. Compaction shall be performed by using vibrating screeds or plates as directed. No construction joints will be required. Immediately after concrete placement, the permeable concrete base shall be cured by covering the entire surface and exposed edges with white-pigmented curing compound in accordance with Subsection 501.17.

### 214.04 PROTECTION

The Contractor shall protect the permeable asphalt base and permeable concrete base from severe weather conditions and contamination by dust, dirt, mud or other fine grained material. The base shall be protected by an approved method from the time of placement until placement of the following pavement layer. No traffic will be permitted on the permeable asphalt base or permeable concrete base. Equipment required to place the pavement will be allowed provided that it enters and exits as near as possible to the paving operation. Any damage to the permeable bases caused by the contractor's equipment shall be repaired by the contractor at no expense to the District. Any portion of the permeable bases that become contaminated to the extent that drainage is reduced or inhibited shall be removed and replaced at no expense to the District. The permeable bases shall be covered with the pavement within 15 working days after placement.

### 214.05 TOLERANCES

The finished surface of permeable asphalt base and permeable concrete base shall be uniform and shall not vary at any point more than 0.05 foot above or below the established grade. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft. Permeable asphalt base or permeable concrete base with a surface higher than 0.05 foot above the established grade shall be removed and replaced with permeable base that complies with these specifications, or when permitted, the high spots may be removed to within specified tolerance by any method that does not produce contaminating fines nor damage the base to remain in place. Grinding will not be permitted. Permeable base with a surface lower than 0.05 foot below the established grade shall be removed and replaced with permeable base that complies with these specifications. When permitted, low areas not exceeding 1 inch shall be filled with pavement at the time and in the same operation in which the pavement is placed at no cost to the District.

### 214.06 TESTING

Before placing surfacing, the contractor shall core the permeable bases at the locations determined by the Chief Engineer. All cores taken by the contractor shall be given to the Chief Engineer for verification of base thickness.

**214.07 MEASURE AND PAYMENT.**

Permeable asphalt base and permeable concrete base will be measured by the square yard from the design quantities shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven or if design changes are necessary. Design areas of permeable base are based on the horizontal dimensions shown on the plans, the length being along the centerline of the base.

Payment for permeable asphalt base and permeable concrete base will be made at the contract unit price per square yard, which payment will include all labor, tools, equipment and incidentals required to complete the specified work.

**215 EXCAVATIONS AND RESTORATIONS (UTILITY LINES)****215.01 DESCRIPTION**

The work performed in conjunction with the placement or repair of utility lines consists of trenching, shoring, sub grade replacement, surface course replacement, and pavement marking replacement for composite pavements, PCC pavements, and flexible pavements. The work shall be performed by utility companies or their contractors, herein referred to as "Contractor", and shall be subject to Chapter 34 of the Public Space Regulations (title 24, DCMR). In the event of any inconsistency with another provision of these specifications, the most stringent requirement shall govern. These specifications shall be used in conjunction with the Department of Transportation Standard Drawings for utility excavation repairs.

**215.02 USE OF STEEL PLATES**

The Contractor shall place the appropriate notification signs if steel plates are used at any point in the processes described herein. Further, the Contractor shall notify the Director, District of Columbia Department of Transportation or his or her designee before placing any steel plates in the Public Right-of-Way.

**215.03 COMPOSITE PAVEMENTS.**

- (A) **TRENCH EXCAVATION.** The Contractor shall cut the full depth of pavement to a neat line by means of a power saw, as per the standard drawings.
- (B) **TRENCH BACKFILL FOR TEMPORARY RIDING SURFACE.** The Contractor shall backfill with approved materials placed in 6 inch lifts to within 4 inches of grade.

The Contractor may use flowable fill as a backfill. If this option is employed, then the 6 inch shoulder described in 215.03(D) is not required, and the new base course described in 215.03 (D) shall be anchored to the existing base on one side, as per the standard drawings.

- (C) **TEMPORARY RIDING SURFACE.** The Contractor shall place 4 inches of Hot Mix Asphalt to grade, as per the standard drawings.

**(D) RESTORATION OF BASE COURSE**

- (1) **RESTORATION CUT.** The Contractor shall cut the pavement parallel to the roadway's longitudinal joints, with a minimum of 6 inches of shoulder beyond the original cut. If this places the restoration cut within 2 feet of a joint in the base course, the cut shall be extended to the joint. The asphalt surface course shall be cut full-depth to a neat line by means of a power saw. The base course shall be cut in the same manner to a depth of at least 3 inches. Pneumatic tools shall be used to remove the remaining portion of the base course, as per the standard drawings.
- (2) **REPLACEMENT OF BASE COURSE.** The Contractor shall place Portland Cement concrete base course to a minimum depth of 10 inches. The bottom of the new base course shall be even with the bottom of the existing in place base course. The top of the new base course shall be 2 inches below the riding surface, as per the

standard drawings, so as not to be affected by subsequent milling and overlaying process.

Steel plating is required for a minimum of twenty-four (24) hours to protect the concrete before opening to traffic. Payment for steel plating shall be in accordance with 616.19.

In the winter, the Contractor may bring the PCC base course up to the grade of the roadway as a temporary measure, thereby eliminating the need for a temporary asphalt patch. In this event, the permanent restoration of the site in the manner described in 215.03(E) must be completed no later than April 15 immediately following the winter months during which these measures were taken.

- (3) **TEMPORARY FEATHERING.** Between the time that a concrete base course has cured and the placement of the final asphalt surface, the Contractor shall feather all edges from the existing pavement to the concrete base course with temporary hot mix asphalt or high-performance cold mix, as defined in Section 819, at a rate of three (3) inches per inch of elevation.

**(E) SURFACE COURSE RESTORATION-MILL AND OVERLAY LIMITS**

- (1) **WIDTH.** The Contractor shall mill and overlay the entire width of the affected lane or lanes.
- (2) **LENGTH.** If the utility cut is less than 30 feet in length, the Contractor shall mill and overlay the length of the cut plus the sections from each end of the cut to the nearest traverse pavement joint. If the utility cut is 30 feet or greater in length, the Contractor shall mill and overlay the entire length of the block.
- (3) **SPECIAL CASES.**

- (a) Special Case 1 – Utility cut in two adjacent traffic lanes and crossing a longitudinal pavement joint

$L_1$  = distance in a traffic lane from the start of a utility repair to transverse pavement joint nearest to cross-over to the adjacent lane

$L_2$  = distance in an adjacent lane from the end of the utility repair to the transverse joint nearest to the cross-over from the adjacent lane.

- (i) If  $L_1$  is less than 30 feet, the Contractor shall mill and overlay the length of  $L_1$  plus the sections from each end of  $L_1$  to the nearest transverse joints. If  $L_2$  is less than 30 feet, the same paving requirements apply.
- (ii) If either  $L_1$  or  $L_2$  are greater than 30 feet in length, the Contractor shall mill and overlay the full length of the block.
- (iii) In all cases, the Contractor shall make all cuts in the base course parallel to either longitudinal or transverse joints.

- (b) **Special Case 2 – Diagonal Utility Cut.**

If the utility cut is diagonal, the Contractor must replace the base course slab(s) through which the cut runs from joint to joint. The previous requirements on the length and width of milling and overlaying apply.

**(c) Full Slab Replacement Option**

The Contractor may fully replace all base course slabs affected by utility cuts in lieu of the above option of partial replacement and milling and overlaying of the surface course.

**215.04 PCC PAVEMENTS**

- (A) TRENCH EXCAVATION AND BACKFILL.** The Contractor shall excavate and backfill the trench according to 215.03(A) and (B). Flowable fill is an acceptable option.
- (B) RESTORATION OF PAVEMENT.** The Contractor shall replace pavement from joint to joint for each section affected by a utility cut.

**215.05 FLEXIBLE PAVEMENTS**

- (A) TRENCH EXCAVATION AND BACKFILL.** The Contractor shall excavate and backfill the trench according to 215.03(A) and (B). Flowable fill is an acceptable option.
- (B) RESTORATION OF SUBBASE**
  - (1) RESTORATION OF CUT.** The Contractor shall cut the pavement with a 6 inch shoulder around the trench. All cuts shall be either parallel or perpendicular to the curb. All cuts shall be made to the pavement's full depth and shall be made to a neat line with a power saw.
  - (2) PLACEMENT OF SUBBASE.** The Contractor shall place 12 inches of stone based aggregate to within 7 inches of the riding surface. If the Contractor chooses to use flowable fill, aggregate sub base is not required. The flowable fill shall also be placed to within 7 inches of the riding surface.
- (C) RESTORATION OF PAVEMENT**
  - (1) RESTORATION OF BASE COURSE.** The Contractor shall place 5 inches of approved Base Asphalt in 2 lifts.
  - (2) RESTORATION OF SURFACE COURSE.** The Contractor shall place 2 inches of approved Surface Asphalt to the same grade as the roadway.

**215.06 CROSSWALKS AND SIDEWALKS**

- (A) CROSSWALKS.** If a utility cut intersects one or more crosswalks of any material other than that of the surrounding roadway, the permanent restoration of the crosswalk(s) must restore it to its original condition and shall be made with materials identical to those of the original crosswalk(s).
- (B) SIDEWALKS.** Contractor must restore sidewalk to its original condition, using original bricks taken from the sidewalk, where feasible, or using materials similar to those of the original sidewalk.

**215.07 PAVEMENT MARKINGS**

If any pavement markings are affected by a utility cut, the Contractor shall replace them with temporary pavement markings within 48 hours. Immediately upon the completion of a

permanent repair, the Contractor shall replace temporary pavement markings with permanent markings.

**215.08 REMOVAL OF PAVEMENT MARKINGS**

When the location of underground utilities must be temporarily marked on the overlying pavement, the party requesting the markings shall remove all markings immediately upon:

- a. Completion of the excavation;
- b. At the time the markings are no longer necessary; or
- c. Twenty (20) days after a permit is granted where excavation has not commenced.



## **DIVISION 300 WATER AND SEWER SERVICES**

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### 301 H PILES-THRUST BLOCK

#### 301.01 DESCRIPTION

[Refer to DC WASA Section 2351]

Work includes furnishing all labor, materials, tools and equipment needed to install a complete thrust block foundation pile system as shown in the contract documents.

All piles shall be installed by a Contractor qualified to install H piles. Minimum requirements for qualification shall consist of five years pile driving experience and evidence of a satisfactory completion of at least five pile installations comparable to this project in scope and subsurface conditions.

Related Work specified elsewhere may include but is not limited to:

- 207: Trench Excavation and Backfill.
- 317: Sewer/Water PCC Formwork Construction
- 318: Reinforcing Steel – Sewer/water Work
- 320: Sewer/Water PCC Construction

Reference Codes and Specifications:

- (1) ASTM A36: Specification for Structural Steel.
- (2) AASHTO M31: Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- (3) AWS D1-1: Structural Welding Code.

Sufficiently in advance of the start of pile driving, the Contractor shall submit to the Chief Engineer for review a description of equipment and any necessary existing structures monitoring schedules.

Prior to driving any pile, the Contractor shall submit written certification from the manufacturer that piles meet specification requirements. Certified mill test reports shall also be submitted.

#### 301.02 SUBMITTALS

Shop drawings showing pile layout details and pile splice details shall be submitted per 105.02. Pile hammer manufacturer's details and recommendations shall be submitted with shop drawings.

#### 301.03 MATERIALS

- Steel H Piles-816.02
- Cap Plates-816.02
- Reinforcing Steel, Grade 60 – 812.02

**301.04 CONSTRUCTION REQUIREMENTS**

Requirements of 701.03 through 701.06 apply for this work.

**301.05 MEASURE AND PAYMENT**

The unit of measure for Steel H Piles will be the linear foot.

The number of feet measured will be the actual number of linear feet left in the completed structure of piles acceptably driven as measured along the axis of the pile from the tip of the pile to the approved cutoff elevation. No measurement will be made for cutoffs, broken piles or piles driven out of position.

Payment for Steel H Piles will be made at the Contract unit price per linear foot for size specified, which payment will include temporary and permanent pile splices and welding, all labor, materials, tools, equipment and incidentals needed to furnish and drive piles complete in place.

## 302 VALVE CASINGS

### 302.01 DESCRIPTION

[Refer to DC WASA Section 2605]

Work consists of excavation, backfill and compaction beyond trench excavation limits, disposal of excess material, furnishing and placing valve casings complete with concrete base, piers as needed, precast concrete rings and casing frames and covers at locations indicated in the contract documents and/or as directed.

Reference Codes and Specifications:

- (1) AASHTO M 105: "Standard Specification for Gray Iron Castings".
- (2) AASHTO M91: "Standard Specification for Sewer and Manhole Brick (made from Clay or Shale)".
- (3) ASTM C361: "Standard Specification for Reinforced Concrete Low-Head Pressure Pipe".
- (4) AASHTO M199: "Standard Specification for Precast Reinforced Concrete Manhole Sections".

### 302.02 SUBMITTALS

Shop drawings per 105.02 shall be submitted for precast concrete items, cast-iron frames and covers.

### 302.03 MATERIALS

Reinforcing Steel, Grade 60 – 812.02

PCC Base – Cast-in-place per 817, Class B, or precast per 822.04

PCC Piers – Precast per 822.04

Precast PCC Risers – 822.04

Casing Brick – 806.01(A)

Casing Frames and Covers – 815.04

Mortar – 806.05(B)(4)

### 302.04 CONSTRUCTION REQUIREMENTS

Casings shall be furnished and constructed over gate valves, suction and dead-end air/drain blow-offs, two-inch air valves, 6-inch drain blow-offs and 6-inch air blow-offs as per Standard Drawings W-20.01, W-50.10, W-50.11, W50.12 and W50.13. Excavation and backfill shall be included as part of work, and shall be per 207.

Casings shall be constructed of precast PCC rings. Casings, frames and covers shall be as detailed in the contract documents. The bottom flange of frame shall have two 3/4-inch diameter holes drilled or cast therein, directly opposite each other. Corresponding holes shall be drilled, a minimum of two (2) inches deep, into the precast concrete ring or brick masonry

upon which the frame sits. Steel dowels shall be inserted through and into these holes to prevent lateral movement of frame and cover during backfill operations. Dowels shall be #5 rebar, three (3) inches minimum length. Brick masonry, not exceeding four (4) inches vertical depth, may be used to adjust frame and cover to finished grade.

### **302.05 MEASURE AND PAYMENT**

The unit of measure will be each.

Payment for Valve Casing will be made at the Contract unit price per each, which payment will include excavation and backfill beyond trench excavation pay limits, concrete base and piers, risers, frames and covers, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

### 303 ABANDONING VALVE CASING AND HYDRANTS

#### 303.01 DESCRIPTION

Work consists of abandoning water valve casings either by removal, partial removal, bulkheading, or any combination thereof, and removal of fire hydrants. Work includes excavation, disposal of unusable materials, bulkheads, and backfill and compaction.

#### 303.02 MATERIALS

Brick – 806.01(A)

PCC – 817, Class B

Mortar – 806.05(B) (5)

#### 303.03 CONSTRUCTION REQUIREMENTS

- (A) **ABANDONING VALVE CASINGS.** Portions of valve casings within three (3) feet below approved roadway subgrade shall be totally removed. Portions lower than three (3) feet below subgrade shall be abandoned in place. Open ends of abandoned water main at the manhole shall be bulk headed at the manhole by either nine (9) inch thick brick masonry in 36 inch diameter and larger openings or nine (9) inch thick brick masonry or PCC of approved mix design in smaller size openings. Work includes backfill with embankment fill and its compaction to sub grade per 203. Usable manhole frames and covers and precast manhole rings shall be removed with care and reused on the contract or delivered to District Property Yard as directed. Unusable items shall be included in disposal.
- (B) **REMOVE FIRE HYDRANT.** Remove Fire Hydrant shall include removal of boot, standpipe and hydrant complete. Work includes backfill with embankment fill and its compaction to sub grade per 203. Usable hydrant components shall be removed with care and delivered to a designated District Property Yard as directed. Unusable items shall be included in disposal.

#### 303.04 MEASURE AND PAYMENT

The unit of measure will be each.

Payment for Abandoning Valve Casings and Remove Fire Hydrant will be made at the contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete work specified.

## 304 BUTTERFLY VALVE MANHOLES

### 304.01 DESCRIPTION

[Refer to DC WASA Section 2607]

Work consists of excavation, backfill and compaction beyond trench excavation limits, disposal of excess material, furnishing and placing butterfly valve manholes complete with concrete base, frames and covers at locations indicated in the contract documents and/or as directed. Butterfly valve manholes shall be built over butterfly valves 12-inches through 36-inches diameter.

Related Work specified elsewhere may include but is not limited to:

305: Pipe Water Main – Ductile Iron.

306: Gate/Butterfly Valves.

Reference Codes and Specifications:

- (1) AASHTO M105: “Standard Specification for Gray Iron Castings”.
- (2) ASTM A74: “Standard Specification for Cast-Iron Soil Pipe and Fittings”.
- (3) AASHTO M31: “Standard Specification Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”.
- (4) AASHTO M91: “Standard Specification for Sewer and Manhole Brick (made from Clay or Shale)”.
- (5) ASTM D2146: “Standard Specification for Polypropylene Plastic Molding and Extrusion Material”.
- (6) AASHTO M199: “Standard Specification for Precast Reinforced Concrete Manhole Sections”.

### 304.02 SUBMITTALS

Shop drawings per 105.02 shall be submitted for cast- iron frames and covers.

### 304.03 MATERIALS

Reinforcing Steel, Grade 60 – 812.02

Cast-in-Place PCC – 817, Class B

Manhole Brick – 806.01(A)

Manhole Steps – 822.07

Manhole Frames and Covers – 815.04

Cast-Iron Sump – Cast-iron soil pipe shall be per ASTM A 74, Service classification

Mortar – 806.05(B) (5)

**304.04 CONSTRUCTION REQUIREMENTS**

Manholes shall be constructed over butterfly valves up to 36-inches diameter as shown in the Contract Documents. Excavation and backfill shall be per applicable subsections of 207.

Manholes shall be constructed of brickwork on a reinforced concrete base, with manhole frames and covers set to approved grade as detailed in the contract documents. Manhole brickwork shall be plumb, true to line, with level and accurately spaced courses, with each course breaking joint with the course below. Joints shall not be less than 3/8 inch nor more than 1/2 inch with a minimum of one header course to every six (6) stretcher courses. Each brick shall be placed with a full joint in a full bed of mortar, shoved up against adjacent brick so that the mortar rises between and completely fills the vertical joint. Exterior surfaces of manholes shall be completely coated with a 1/2 inch mortar parging and made watertight. Manhole steps shall be placed with step legs embedded 7-3/8 inches into the brickwork. Brick masonry walls shall be nine (9) inches thick; thickness shall be increased to 13 inches when the manhole depth exceeds 15 feet.

Brick masonry shall not be placed when the ambient air temperature is below 40 deg. F or when it appears probable that temperatures below 40 deg. F will be encountered before mortar can set, unless adequate approved means are provided for protecting the work from freezing. Work shall be protected by heating and maintaining the temperature of the masonry materials at not less than 40 deg. F and maintaining the air temperature above 40 deg. F on both sides of the masonry for not less than 72 hours. Work with, or on, frozen material is prohibited.

During hot weather, masonry shall be protected from direct rays of the sun. All finished work shall be covered and kept damp for a period of seven (7) days after placement.

Mortar shall be freshly mixed for prompt use; no mortar shall be used after setting or beyond one hour after the addition of water. Re-tempered mortar and freeze-preventive chemical additives are prohibited. The mixing machine, batch size, and mixing time shall be approved by the Chief Engineer. When hand mixing is used, mixing shall be accomplished in a clean, leak-proof, non-porous mortar box constructed for the purpose. Manhole steps shall be aligned on sidewall opposite valve operator.

The bottom flange of the manhole frame shall have two (2) 3/4-inch diameter holes drilled or cast therein, 180 degrees opposed. With frame in proper position at required grade, corresponding holes shall be drilled, a minimum of two (2) inches deep, into the brick masonry upon which the frame sits. Steel dowels shall be inserted through and into these holes to prevent lateral movement of frame and cover during backfill operations. Dowels shall be No. 5 rebars, three (3) inches minimum length, or approved equivalent.

**304.05 MEASURE AND PAYMENT**

The unit of measure will be each.

Payment for Butterfly Valve Manhole will be made at the Contract unit price per each, which payment will include excavation and backfill beyond trench excavation pay limits, concrete base, riser sections, castings and all labor, materials, tools, equipment and incidentals needed to complete work specified.

### 305 PIPE WATER MAIN – DUCTILE-IRON

#### 305.01 DESCRIPTION

[Refer to DC WASA Section 2610]

Work consists of furnishing and placing water main pipelines complete and ready for continuous service, including pipe, fittings and specials including such as pipe for suction blow-offs and fire hydrants; jointing and harnessing; cutting and connecting to existing system, including additional fittings not shown on contract documents or anticipated in the work but required for a functional system, requisite retainer glands; reconnecting existing mains, testing operations, and providing disinfection, testing, and all incidental work needed for a complete installation.

The District reserves the right to furnish any additional fittings required to complete the Contract in a timely manner and in the District's interest.

Water main pipe 60-inches and smaller diameter shall be ductile-iron pipe unless otherwise specified.

Water main pipe 12-inches and smaller diameter shall be harnessed at all joints, unless otherwise specified.

When a water main is attached to a bridge or other structure, work includes all pipe supporting members such as cross beams (other than diaphragms), bracing, rollers, hangers, connecting hardware, PCC inserts, expansion devices, and appurtenances.

Related work specified elsewhere may include but is not limited to:

- 207 Trench Excavation
- 304 Butterfly Valve Manholes
- 306 Gate/Butterfly Valves
- 307 Fire Hydrants
- 703 Cast-In-Place Concrete
- 322 Concrete Thrust Block
- 324 Concrete In-Line Thrust Block
- 822.04 Precast Concrete Products

#### 305.02 SUBMITTALS

Shop drawings per 105.02 shall be submitted for pipe laying schedule, closure pieces, fittings, specials, joint details, bevel pipe, restraint and harnessing, special designs.

Mechanical and push-on joint restraint methods, including pressure rating from manufacturer, shall be submitted by the Contractor and approved by the Chief Engineer prior to ordering or installing these materials.

Data, affidavits and certifications shall be submitted per referenced AWWA specifications and this Section.

### **305.03 MATERIALS**

Ductile Iron Pipe and Fittings – 809.01

Field Applied Coating System- Coating system shall be coal tar epoxy conforming to AWWA C210. “High-Build Tneme-Tar 46H-413” by Tnemec Co. is considered acceptable.

### **305.04 MATERIALS SUPPLIED BY DISTRICT**

No materials will be furnished by the District to the Contractor.

### **305.05 CONSTRUCTION REQUIREMENTS**

- (A) **GENERAL.** Pipe delivery and distribution shall be scheduled to provide minimum interference with required maintenance of traffic. Pipe delivery shall be coordinated with pipe installation as directed.

Pipe shall be distributed along the line of work and outside the trench as near as practicable to point of placement, facing in the proper direction and properly wedged secure. Pipe shall not be rolled or dragged on the ground. No pipe shall be placed against trees or shrubs or in a manner that may damage private and other property.

Proper measures shall be taken to protect pipe, pipe coating and lining, fittings and appurtenances from injury at all times. No material shall be deposited on or against pipe. Skids and wedges shall be arranged and installed to prevent injury of any kind. Suitable approved tools and equipment shall be used for convenient and safe handling of pipe and fittings.

Prior to placing pipe and fittings in the trench, the interior and exterior of pipe and fittings will be inspected by the Chief Engineer. Pipe or fittings damaged beyond acceptable repair will be rejected and shall be removed and replaced at no cost to the District. Chipped, cracked, scarred or otherwise injured outer coatings on ductile-iron pipe shall be properly repaired as directed at the Contractor’s expense.

Just prior to placement, the inside of all pipe and fittings and the ends of outside surfaces shall be thoroughly cleaned; interior surfaces shall be kept clean throughout construction by use of carefully fitted stoppers. When pipe installation is not actually in progress, approved watertight plugs or caps shall be placed in all open ends of installed pipe. Surfaces of both pipe sections to be in contact with the rubber gasket seal shall be thoroughly wire brushed to remove all loose rust and foreign matter, leaving clean smooth surfaces for jointing.

Trench excavation and suitable beddings shall be complete to proper grade per 207 before pipe is placed. Any adjustment due to improper trench grade or settlement shall be accomplished at the Contractor’s expense. If the pipeline floats or collapses from accumulation of water in the trench or from other causes, approved repair and replacement shall be at no cost to the District.

The Chief Engineer reserves the right to limit the amount of pipe laid in advance of backfilling, but in no case shall the amount exceed 50 linear feet.

Pipe and fittings shall be lowered into trench so ends nearly abut each other. Pipe shall be moved longitudinally in the trench in an approved manner. The entire length of pipe and fittings shall be bedded solidly on the trench bottom to required line and grade. Under no condition shall pipe be subjected to a blow or shock to bring it to the required line and grade.

As part of the work, bell holes shall be excavated to adequate size where needed to accommodate proper joints.

Springing of joints to change direction is prohibited except as noted in (D) JOINTS, DUCTILE-IRON PIPE. Otherwise, change in alignment or grade shall be accomplished by use of pipe fittings which are the same diameter and strength as straight pipe.

Straight pipe shall be furnished in standard uniform lengths. Approved short pipe lengths shall be used where needed to meet line and grade as closure pieces.

When pipe requires cutting, the Contractor shall take field measurements for making, closing, and connecting pieces of correct dimensions. Cutting shall leave a smooth end.

Wall openings in pipe, fittings or appurtenances for air valve taps will be drilled and tapped for 2-inch diameter Mueller pipe thread and provided with brass plugs after pipe installation.

After completion of water main work, unused pipe, fittings and joint restraint pieces shall remain the property of the Contractor and be removed from the site.

- (B) MAINTAINING WATER SERVICE.** Existing water service shall be maintained at all times except when disconnecting or connecting new work. Existing water mains paralleling new water mains shall be kept in service until new water mains are complete, temporarily capped as needed, tested, chlorinated and charged.

Where an existing water main must be cut and connection made to a new water main, work shall be scheduled as directed to minimize service interruption.

The Contractor shall provide needed facilities and work on a 24 hour basis, at no additional District cost, to transfer water connections, complete connections and abandon old water mains. The Contractor shall notify the Chief Engineer and the Department of Water Services for approval at least 48 hours prior to cutting or abandoning a water main.

- (C) CUTTING-IN AND REMOVING CONNECTIONS.** Unless otherwise indicted, the Contractor shall cut existing water mains, remove pipe, fittings, and appurtenances to make required connections; connect new water mains; reconnect existing water mains; and perform all work necessary or incidental thereto.
- (D) JOINTS, DUCTILE-IRON PIPE.** Joints shall be assembled per AWWA C 600 to insure tight, flexible joints that safely permit movement caused by expansion and contraction as well as slight ground settling or shifting.

When horizontal or vertical deflection of pipe from a straight line is necessary, the maximum permissible joint deflection shall not exceed the manufacturer's

recommendations. Keep the pipe straight while pushing the pipe home. The joint deflection shall only be completed after the pipe is homed.

- (1) **Mechanical Joints.** For mechanical joints, contact surfaces shall be cleaned and coated with an approved lubricant just prior to slipping the gasket over plain ends and into sockets. The plain end shall be centrally placed into the socket. The inside of the socket and the outside of the plain end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the socket. A thin film of approved gasket lubricant as supplied by the pipe manufacturer shall be applied to either the inside surface of the gasket or to the plain end or both. Pipe plain end shall be entered into the socket with care to keep lubricated surfaces from contracting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with an approved forked tool, jack-type tool or other device. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that plain end is inserted to full depth. Field cut pipe lengths shall be filed or ground to resemble the plain end of pipe as manufactured.

When tightening tee-head bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining about equal distance between gland and flange face at all points around the socket. This may be achieved by partially tightening bottom bolt first, then top bolt, then side bolts, then remaining bolts. Cycle shall be repeated until all bolts are within required torque range.

Nominal tee-head bolt torque range shall be as follows:

<b>Bolt Size (inches)</b>	<b>Torque Range (foot-pounds)</b>
5/8	45-60
3/4	75-90
1	100-120
1-3	120-150

The above torque loads shall be applied with torque measuring or indicating wrenches furnished by the Contractor and witnessed by the Chief Engineer.

- (2) **Push-on Joints.** For push-on joints, the outside diameter of existing pipe to be joined shall be identical to the outside diameter pipe to be installed. The inside of the socket and the outside of the plain end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the socket. A thin film of approved gasket lubricant as supplied by the pipe manufacturer shall be applied to either the inside surface of the gasket or to the plain end or both. The pipe plain end shall be entered into the socket with care to keep lubricated surfaces from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with an approved forked tool, jack-type tool or other device. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the plain end is inserted to full depth. Field cut pipe lengths shall be filed or ground to resemble the plain end of pipe as manufactured.

A retainer gland shall not be used on any pipe joint or fitting connecting ductile-iron pipe to existing cast-iron pipe.

After each ductile-iron pipe, fitting and valve is jointed complete, each joint area including restraint elements shall be cleaned, inspected and approved before next section is installed. Bolts, clamps, and all parts including thread areas, etc., shall receive one prime coat and one finish coat of field-applied coating system applied in accordance with AWWA C210. Field coatings shall be complete prior to line tests.

Unless otherwise specified, the diameter of ductile-iron plain ends shall be the same as for mechanical-joint cast or ductile-iron pipe.

**(E) BOSSED DUCTILE-IRON PIPE (30-INCH AND LARGER DIAMETER WATER MAIN).** Field installation and protection of bossed outlet pipe and field connections thereto shall be strictly per contract drawings and as recommended by the bossed outlet pipe manufacturer.

**(F) SLEEVE TYPE COUPLINGS.** Pipe end condition:

- (1) Pipe for use with sleeve couplings shall have plain ends cast or machined at right angles to the pipe axis. Use sleeve-type couplings only where indicated in the contract documents.
- (2) Ductile-iron and cast-iron pipe shall be smooth and round for a distance of eight (8) inches from the end of the pipe up through 24-inch diameter, and for 12 inches from the end of the pipe for pipe larger than 24-inch diameter. The maximum variation from nominal O.D. shall not exceed:

Pipe Size	Variation Max./Min.
3 thru 16-in.	≡ ~0.06 in.
18 thru 24-in.	∇ 0.08 in.
30 thru 42-in.	∇ 0.10 in.
48-in.	∇ 0.12 in.
54 thru 60-in.	≡ ~0.15 in.

The maximum actual O.D. of pipe end shall be such as to permit the passing of a ring gauge having an internal bore not greater than 0.01 inch larger than the nominal O.D. plus the variation maximum indicated above.

- (3) Steel pipe larger than 10 3/4 inches O.D. shall be free from indentations, projections or roll marks for a distance of eight (8) inches from the end of the pipe and, within this distance, the actual O.D. shall be not more than 1/32 inch smaller than the nominal O.D. The maximum actual O.D. of the pipe end shall be such as to permit the passing of a ring gauge having an internal bore not greater than 3/32 inch larger than the nominal pipe O.D.
- (4) For each type of pipe, the minimum actual O.D. shall be determined by use of a steel tape applied circumferentially to the pipe.

Assembly:

- (1) Provide sleeve couplings where shown on the contract drawings. Sleeve couplings without pipe stops shall be used at butterfly valves 30-inch and larger diameter. Couplings shall be of proper sizes for the valve ends.
  - (2) Provide additional units as needed for flexibility and convenience for completing installation and locate as directed.
  - (3) Couplings shall be assembled on the job in a manner to insure permanently tight joints under all reasonable conditions of expansion, contraction, shifting and settlement, unavoidable variations in trench gradient, etc.
  - (4) Clean all dirt, rust, oil, or loose scale from the pipe end. Check surfaces where the gasket contacts the pipe to insure there are no imperfections such as gouges or grooves that will impair the performance of the gasket seal.
  - (5) If factory applied coating on sleeve-type coupling components is damaged in the field, the damaged surfaces shall be re-coated in accordance with the manufacture's recommendations before the field connection is made. Any damage from field assembly shall be repaired in similar manner.
  - (6) Measure back on each pipe end one-half of the middle ring length plus two (2) inches and place a chalk mark to be used for centering the coupling over the joint to be coupled.
  - (7) Slide follower(s) over pipe end(s).
  - (8) Wipe gaskets clean and lubricate gaskets, pipe O.D., and middle ring flares with soapy water or a non-petroleum-base lubricant. (Alcohol may be added to soapy water in freezing weather.)
  - (9) Slide gasket(s) over pipe end(s) and assemble middle ring on one pipe end.
  - (10) Stab other pipe end into middle ring and center coupling between chalk marks. Pipe end must be past the end of gasket a minimum of one (1) inch after deflection has occurred.
  - (11) Insert bolts for down stroke tightening where applicable. Bolts on opposite sides of pipe will be in opposite directions.
  - (12) Tighten bolts on opposite sides, drawing up the followers evenly, until all bolts have been tightened to the torque recommended by the manufacturer. Check torque on bolts prior to backfilling.
- (G) **DRAIN OR AIR BLOWOFFS.** Drain or air blowoffs, shall be included as part of work and shall be constructed as shown in the contract documents.

Gate valves and valve casings shall be included under 306 and 302 respectively.

**(H) JOINT RESTRAINT.**

All thrust due to static and dynamic forces, including water hammer, at bends, tees, wyes, valves, fire hydrants, drain blowoffs, and dead end blowoffs shall be counteracted by an approved restraint method, whether or not indicated in the contract documents. When

connecting pipe or fittings to existing facilities, provide sufficient restraint to counteract all thrusts.

All 12 inch and smaller diameter mechanical joint water mains and fittings, including valves and fire hydrants, shall be installed using ductile-iron retainer glands in place of standard follower glands.

Where shown in the contract documents, pipe and fittings shall be restrained by concrete thrust blocks per Section 322 or 324. If applicable, steel H piles per Section 301 shall be furnished and installed.

Concrete for thrust blocks shall be Class 4000.

Provide factory-welded steel thrust collars or retainer glands embedded in in-line thrust blocks where shown in the contract documents.

Restraint of thrust forces in push-on joint ductile-iron pipe shall be provided by an approved proprietary harnessing system installed in accordance with manufacturer's printed instructions. Work includes all excavation necessary to install harnessing.

Restraint of mechanical joint ductile-iron pipe shall be accomplished by using approved ductile-iron retainer glands in lieu of follower glands, installed in accordance with manufacturer's printed instructions.

Torque range for retainer gland set screws shall be in accordance with manufacturer's recommendations.

Provide and install drilled steel thrust collars, rods and other harnessing as shown in the contract documents.

T-bolts, harness tie rods, coupling bolts, flanged joint bolts, etc. shall be installed to provide at least one complete thread projecting beyond the nut when properly tightened. Any such threaded component that fails to meet this requirement shall be replaced at no additional cost to the District.

After each ductile-iron restrained joint is complete, the joint restraint elements shall be cleaned and inspected. Restraint elements fabricated from mild steel or other materials subject to corrosion shall be protected against corrosion using field-applied primer and coating system per AWWA C210. All coatings shall be complete before line testing.

**(I) EXTRA FITTINGS/SPECIALS.** Prior to making corrections to existing pipe, for closure sections and for field changes due to unanticipated interferences, the Contractor shall:

- (1) Verify the size of existing pipe in service and provide pipe and fittings with sleeve couplings per 809.01(D) to connect to existing pipe or to complete a closure. Limits of pipe and fittings for this purpose shall be approved on detailed drawings submitted by the Contractor to permit closure or to meet fixed outlet points by field alteration of approach lengths to compensate for differences between design and actual laying lengths; and/or
- (2) Verify unanticipated interferences and provide additional fittings as needed and as approved on detailed drawings submitted by the Contractor to permit field changes in line and grade needed due to unanticipated obstructions in the actual locations of

interfering underground structures or junction water main, including use of additional fittings.

Fittings and adjustments necessary to facilitate closures and proper connections shall be included in the work whether or not indicated in the contract documents. Drawings show the more likely arrangement of fittings and specials, but these details cannot be guaranteed due to inevitable field conditions and adjustments.

Where connections to existing pipe, closure sections or unanticipated obstructions require a change in line or grade of proposed water main alignment, Extra Fittings-Contractor Furnished and requisite retainer glands for 24-inch and smaller diameter ductile-iron pipe water main shall be furnished and installed.

For such cases, when in the District's interest and as determined by the Chief Engineer, the District may furnish Extra Fittings including gaskets, retainer glands and incidentals for 24-inch and smaller diameter ductile-iron pipe water main. These items will be furnished, at no cost to the Contractor, for installation by the Contractor.

### **305.06 WATER MAIN TESTS**

#### **(A) GENERAL.**

The Contractor shall be responsible for the planning, coordination and execution of a combined pressure and leakage testing of water mains prior to their being placed in service. The pressure and leakage test shall be conducted in accordance with ANSI/AWWA C-600, except as modified herein.

After water main pipe has been installed, it shall be subjected to combined pressure and leakage test. Regardless of length of water main in project, all segments shall be tested unless otherwise approved by the Chief Engineer.

Contract work shall remain separated from the existing distribution system, except for test connections, until the pressure and leakage test and chlorination work has been complete, and connection to the water distribution system is approved by the Chief Engineer. Testing against closed valves shall not be permitted.

The Contractor shall perform all work necessary to complete testing. This shall include furnishing all labor, materials and equipment including pumps, gauges, charts, meters, and water source connections. Test gauges shall have pressure scale increments of no more than two (2) psi. and the gauges shall have been purchased new or have been tested and their calibration certified within one year of the proposed date of the test.

The Contractor shall provide and install approved caps and plugs in sections to be tested. Openings in pipe and fittings shall be closed tight to prevent leakage. All temporary plugged and capped ends shall be properly blocked to prevent displacement and leakage. The Contractor shall install a water source connection to the isolated pipe section for test purposes as directed. If a water main tap is approved for test connection to new water main, the tap will be furnished and installed by the DC WASA at no cost to the Contractor.

If the Contractor should choose to conduct tests prior to backfilling, he shall be responsible for providing and installing temporary blocking to properly restrain pipe. Temporary blocking shall be approved by the Chief Engineer prior to testing.

Upon test completion and approval of samples tested for bacteriological quality, the Contractor shall remove temporary caps, plugs and other temporary construction and shall complete connections of new work to the water distribution system.

All materials and equipment furnished by the Contractor for water main testing, including, closure caps, plugs and other temporarily required accessories shall remain the property of the Contractor upon completion of testing.

**(B) PRESSURE AND LEAKAGE TEST:**

Pressure Test (psi) = (R.E.P.- Test Sec. El.) x .433 or 150 psi which ever is greater.

Where: R.E.P. = Reference Elevation for Testing from Table 305.06-2 for the appropriate service area, and

Test Sec. El. = Elevation based on the low point elevation in the line or section under test.

Gauge reading shall be corrected for the elevation difference between gauge and low point in test section.

**TABLE 305.06-1  
REFERENCE ELEVATIONS FOR PRESSURE AND LEAKAGE TESTS**

WEST OF ANACOSTIA RIVER					EAST OF NACOSTIA RIVER			
	1 <sup>ST</sup> HIGH	2 <sup>ND</sup> HIGH	3 <sup>RD</sup> HIGH	4 <sup>TH</sup> HIGH (East) <sup>(1)</sup>	4 <sup>TH</sup> HIGH (West) <sup>(1)</sup>	LOW	1 <sup>ST</sup> HIGH	2 <sup>ND</sup> HIGH
403	481	566	655	716	787	403	489	613

Field Pressure and Leakage Test:

Each segregated section to be tested shall be subjected to a hydrostatic test pressure which shall Be of at least two hours duration and not vary by more than + 5 psi from the specified test pressure for the duration of the test.

Leakage shall not exceed the total computed from the Table 305.6-2 as determined by the following formula:

$$L = \frac{SD \times P^{0.5}}{133,200}$$

Where:

- L = Allowable leakage in gallons per hour
- S = Length of pipe tested in feet
- D = Nominal diameter of the pipe in inches
- P = Average test pressure during the test in pounds per square inch

**TABLE 305.06-2**  
**MAXIMUM ALLOWABLE LEAKAGE PER 1000 FEET OF PIPELINE\* – GPH**  
 6 Through 48-Inch Nominal Diameter Pipe  
 Nominal Diameter Pipe in Inches

Average Test Pressure		6-inch	8-inch	12-inch	16-inch	20-inch
Psi.	(Bar)					
450	(31)	0.95	1.27	1.91	2.55	3.18
400	(28)	0.90	1.20	1.80	2.40	3.00
350	(24)	0.84	1.12	1.69	2.25	2.81
300	(21)	0.78	1.04	1.56	2.08	2.60
275	(19)	0.75	1.00	1.49	1.99	2.49
250	(17)	0.71	0.95	1.42	1.90	2.37
225	(16)	0.68	0.90	1.35	1.80	2.25
200	(14)	0.64	0.85	1.28	1.70	2.12
175	(12)	0.59	0.80	1.19	1.59	1.98
150	(10)	0.55	0.74	1.10	1.47	1.84

Average Test Pressure		24-inch	30-inch	36-inch	42-inch	48-inch
Psi.	(Bar)					
450	(31)	3.82	4.78	5.73	6.69	7.64
300	(21)	3.12	3.90	4.68	5.46	6.24
275	(19)	2.99	3.73	4.48	5.23	5.98
250	(17)	2.85	3.56	4.27	4.99	5.70
225	(16)	2.70	3.38	4.05	4.73	5.41
200	(14)	2.55	3.19	3.82	4.46	5.09
175	(12)	2.38	2.98	3.58	4.17	4.77
150	(10)	2.21	2.76	3.31	3.86	4.41

\*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

Any section that fails the pressure and leakage test shall be repaired by the Contractor. The Contractor shall then retest the section until approved at no additional costs to the District.

All visible leaks shall be repaired regardless of the amount of leakage.

**Pressurization:**

Each section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Chief Engineer.

The system shall be allowed to stabilize at the test pressure before conducting the test.

**Air Removal:**

Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air valves are not located at all high points the Contractor shall expose the entire pipe circumference at those points and install corporation cocks at such points so that trapped air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At conclusion of pressure and leakage tests, the corporation cocks shall be removed the tapped holes shall be capped with brass plugs.

Any damaged or defective pipe, fittings, valves or hydrants that are discovered following the pressure and leakage test shall be replaced by the Contractor and the test shall be repeated until work is satisfactory

**(C) CHLORINATION.**

The Contractor shall disinfect all water mains installed under the Contract by chlorination. Disinfection operations shall be in accordance with the American Water Works Association Standard for Disinfecting Water Mains (ANSI/AWWA C651).

The Contractor shall submit for review and approval his detailed plan for disinfection of each water main segment. The plan shall include the location(s) where the disinfectant is to be introduced, the type and the amount of disinfection to be applied, the target residual concentration and contact period. The plan shall include specific information on the locations where flushing is to be accomplished, rates of flushing, and locations of drainage facilities. Flushing water shall be directed to a sanitary or combined sewer unless impracticable. If discharge to an alternate location (e.g. storm sewer or natural stream) is proposed, details on methods of dechlorination shall be provided in the plan. The plan shall include information on location of sample locations. At least one sample tap shall be provided for each main or branch greater than 50 feet long, at a spacing interval of no more than 500 feet, and at the end of the main. Temporary sample taps along the water main shall be provided as shown in the Contract Documents.

The Contractor shall furnish all labor, materials and equipment including piping, pumps, gauges, charts, meters, and water source connections necessary to complete disinfection and sampling for water quality tests.

Disinfectant to be used shall be either calcium hypochlorite granules or tablets. Chlorination plan shall include the amount of disinfectant to be applied and the target residual concentration and contact period.

Samples for bacteriological tests will be taken by the WASA inspector using sterile bottles with sodium thiosulfate dechlorinating reagent added. Initial samples will be taken of the water that has stood in the new or restored main for at least 16 hours after final flushing has been completed. Confirmatory samples will be taken at least 24 hours after the first sample.

Disinfection operations shall be considered successful if test results show the water main segment to be free of coliform contamination. Should the first round of tests fail these criteria, the mains shall be re-flushed, re-disinfected and re-sampled for compliance.

New fittings and short pipe segments necessary for reconnection of the new main or out-of-service main to the existing distribution system shall be spray disinfected or swabbed with a minimum 1 percent solution of chlorine immediately prior to connection.

The Contractor shall submit a summary report on each disinfection operation within one month of acceptance of the pipe for service. The report shall outline the limits of the main disinfected, the method of disinfection used, dosage of disinfectant applied, and results of bacteriological sample analysis provided by the District.

- (D) TESTING TIME PERIOD.** Pressure and leakage tests, and chlorination of water mains shall be ten (10) consecutive calendar days or as indicated in the contract documents.

If the time elapsed from the date when the water main is capped and readied for test until the date of its acceptance by the Chief Engineer exceeds ten (10) calendar days, an extension of time may be granted upon Chief Engineer approval.

- (E) CONNECTION.** All joints assembled for connection to existing pipe that are not tested shall not be backfilled before pipe line is placed under pressure and visually inspected for leaks. All leaks shall be repaired and the repairs approved by the Chief Engineer prior to backfilling the trench.

### **305.07 MEASURE**

The unit of measure for Ductile-Iron Pipe Water Main will be the linear foot, with measure taken along center line of pipe, including fittings, except Extra Fittings-Contractor Furnished, complete in place, with laying lengths of valves deducted. Reducers will be measured as pipe equivalent to the larger end size. When crossing a bridge, measure will also include pipe rollers, straps, and connecting hardware.

The unit of measure for Extra Fittings-Contractor Furnished will be the pound, as determined from the nominal tabulated weight of the fitting before the application of any lining or coating other than standard coatings). Weight of retainer glands, bolts, nuts and gaskets will not be measured. The weight of any fitting shall not be less than the nominal tabulated weight by more than ten (10) percent. No separate measure will be made for Extra Fittings – District Furnished.

### **305.08 PAYMENT**

Payment for Ductile-Iron Pipe Water Main will be made at the Contract unit price per linear foot, which payment will include all joints and fittings (except Extra Fittings – Contractor Furnished), specials and closure pieces, harnessing, lining and coatings, additional tests subsequent to first test, chlorination, testing, installation of Extra Fittings – District Furnished, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Extra Fittings-Contractor Furnished will be made at the Contract unit price per pound, which payment will include all extra fittings and requisite retainer glands, gaskets, bolts, nuts and all labor, materials, tools, equipment, tests and incidentals needed to complete extra fittings work.

Payment for Extra Fittings – District Furnished will not be made. Payment for installation of District furnished fittings will be included in Contract unit price per linear foot for Ductile-Iron Pipe Water Main.

No separate payment will be made for air and drain blowoffs. Excavation required will be included in trench excavation; tees, bends, pipe, joints and standpipe will be included in water main work; 6-inch valve and valve casing(s) will be paid as separate items.

Two-inch gate valve, caps and standpipe on dead end units shall be included as part of water main work.

## 306 GATE/BUTTERFLY VALVES

### 306.01 DESCRIPTION

[Refer to DC WASA Section 2640]

Work consists of furnishing and installing gate and butterfly valves. Gate valves may be either standard or resilient-seated type. Excavation and backfill, if necessary, and valve casings are included as part of Valve Casings per 302, harnessing is included as part of Pipe Water Main Ductile-Iron per 305, Butterfly Valve Manholes per 304 or Valve/Venturi Vaults when applicable per 321. Work includes gate valves for drain blowoffs.

Related work specified elsewhere may include but is not limited to:

- 302: Valve Casings
- 304: Butterfly Manholes
- 305: Pipe Water Main – Ductile Iron
- 321: PCC Valve/Venturi Vaults

Reference Codes and Specifications:

- (1) ASTM A48: “Standard Specification for Gray Iron Castings”.
- (2) AASHTO M91: “Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)”.
- (3) ANSI B16.1: “Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800”.
- (4) ASTM A48: “Specification for Gray Iron Castings”.
- (5) ASTM A153: “Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware”.
- (6) ASTM A536: “Specification for Ductile-Iron Castings”.
- (7) ASTM B584: “Specification for Copper Alloy Sand Castings for General Applications”.
- (8) AWWA C104: “AWWA Standard for Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water”.
- (9) AWWA C203: “AWWA Standard for Coal-Tar Protective Coatings for Steel Water Pipelines – Enamel and Tape – Hot Applied”.
- (10) AWWA C500: “AWWA Standard for Gate Valves, 3 through 48-In. NPS, For Water and Sewage Systems”.
- (11) AWWA C504: “AWWA Standard for Rubber-Seated Butterfly Valves”.
- (12) AWWA C509: “AWWA Standard for Resilient-Seated Gate Valves, 3 through 12 NPS, For Water and Sewage Systems”.
- (13) AWWA C550: “AWWA Standard for Protective Interior Coatings for Valves and Hydrants”.
- (14) U.S. Army Corps of Engineers C200.

**306.02 SUBMITTALS**

Drawings per 105.02 shall be submitted for valve and joint details.

Affidavits, certificates, and manufacturer's test results shall be submitted per this Section, including:

**(1) For Gate Valves:**

Catalog Data – Prior to purchase of the valve, the Contractor shall submit to the Chief Engineer, for approval, catalog data, net weight, and certified assembly drawings. No valve shall be furnished or installed unless approved in writing by the Chief Engineer.

Affidavit – An affidavit of compliance shall be furnished by the manufacturer that specifies tests have been performed and that all components and the product comply in all respects with requirements of specifications.

Records of Tests – Record of physical and chemical properties, operating and hydrostatic tests shall be furnished.

**(2) For Butterfly Valves:**

Test data shall be furnished by the manufacturer.

The Contractor shall submit manufacturer's certified drawings of the valves including valve operators, gear ratios, electrical schematics (where electrical operators are furnished), and parts lists.

An affidavit from the manufacturer shall be submitted stating that valves furnished comply with all applicable provisions of this specification.

Certified test reports covering performance, leakage, and hydrostatic tests shall be furnished.

The Contractor shall submit a statement giving required number of turns of the operating nut to move the disc from fully open to fully closed (or vice versa) position.

**306.03 MATERIALS**

Gate Valves – 810.01(A)

Resilient-Seated Gate Valves – 810.01(B)

Butterfly Valves – 810.01(C)

**306.04 CONSTRUCTION REQUIREMENTS**

- (A) PRIOR TO INSTALLATION INSPECTION.** Gate valves will be inspected at the time of receipt for damage in shipment, compliance with specifications, direction of opening, size and shape of operating nut, number of turns, and type of end connections. A visual inspection of the bronze gate rings and body rings will be performed to detect any damage in shipment or scoring of the seating surfaces. Any foreign material in the interior portion of the valve shall be removed. The valve will be cycled through one complete opening and closing cycle.

- (B) **INSTALLATION.** Six-inch through 12-inch diameter gate valves shall be installed vertically in the water main by means of standard mechanical joints per 305.

Valves 16-inches through 24-inches diameter shall be butterfly valves installed with mechanical joints per 305.

Valves 30-inches diameter and larger shall be butterfly valves installed with flanged joint ends bolted to accompanying flanged and plain-end pieces such that the plain-ends will accommodate flexible rubber-packed mechanical sleeve couplings, and shall meet the requirements for tolerance of ends of steel pipe to be coupled in a similar manner as described in AWWA C 201 or C 202. The exterior of the flanged and plain-end pieces shall be coated with a suitable bituminous coating and the interior lined with cement mortar per AWWA C 104.

Valves shall be installed in the closed position.

- (C) **AFTER INSTALLATION INSPECTION.** After installation and before pressurization of the valve, all pressure-containing bolting (bonnet, seal-plate, bypass, and end connections) will be inspected for adequate tightness of all tapped and plug openings to the valve interior. The Contractor shall make any adjustments or alterations as directed.
- (D) **TESTS.** Pressure test will be conducted as part of the water main test per 305.

### **306.05 MEASURE AND PAYMENT**

The unit of measure will be each.

Payment for Gate/Butterfly Valve will be made at the contract unit price per each, which payment will include flanged and mechanical joint ends, flanged and plain-end pieces where needed along with sleeve couplings, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

### 307 FIRE HYDRANTS

#### 307.01 DESCRIPTION

[Refer to DC WASA Section 2642]

Work consists of furnishing and setting fire hydrants, (boot with ductile iron retainer gland,, standpipe and hydrant complete) adjusting hydrants to grade, relocating hydrants, converting fire hydrants to traffic type, plus constructing dry wells and thrust blocks complete, at locations indicated in the contract documents or as directed. Work includes restoration of landscape features and sodding per 610.05. Trench excavation and backfill, hydrant connecting pipe, restraint, water valve and water valve casing are not part of work.

- (A) **SET FIRE HYDRANT.** Work consists of furnishing and installing new traffic type fire hydrants, necessary tees, elbows, other fittings, and other incidental materials to complete work.
- (B) **RELOCATE FIRE HYDRANT.** Work consists of relocating fire hydrants at new location. Work includes furnishing of all items in (A) except for the fire hydrant. Work includes removal of the hydrant from its original location and reinstallation of existing hydrant, if traffic type, or installation of a new hydrant, furnished under (D), at new location. Work shall include installation of necessary fittings.
- (C) **ADJUST FIRE HYDRANT.** Work consists of adjusting fire hydrants to new grade at the existing location. Work includes removal of the existing hydrant and removal or addition of vertical pipe, and reinstallation of the existing hydrant, if traffic type, or installation of a new hydrant, furnished under (D), to new grade. Hydrant lowering may also require lowering of the dry well. However, when field conditions require lowering the connecting water line, work shall be considered as “Relocate Fire Hydrant”.
- (D) **FURNISH FIRE HYDRANT.** Existing fire hydrants to be relocated or adjusted, which are not traffic type or otherwise not suitable, shall not be reused. Work under this item consists of furnishing a new traffic type fire hydrant and reducer for use in completing the work specified in (B) or (C). Work includes delivering the existing hydrant to the Bureau of Water Services property yard at either 2nd Street and Bryant Street, N.W., or 18th Street and Minnesota Avenue, S.E., as directed, with a credit requisition furnished by the Chief Engineer and approved by an authorized representative of the DC WASA Utility Inspection Branch.
- (E) **CONVERT FIRE HYDRANT.** Work consists of replacing existing non-breakaway type fire hydrants with new traffic type fire hydrants at the original location and elevation. Work includes removal and hauling the existing hydrant, as specified in (D), and furnishing and installing complete the new hydrant.

Related work specified elsewhere may include but is not limited to:

207: Trench Excavation and Backfill.

302: Valve Casing.

305: Pipe Water Main – Ductile Iron.

306: Gate/Butterfly Valves.

Reference Codes and Specifications:

AWWA C502: "AWWA Standard for Dry-Barrel Fire Hydrants".

ASTM D1682: "Test Methods for Breaking Load and Elongation of Textile Fabric".

### **307.02 SUBMITTALS**

Shop drawings per 105.02 shall be submitted for hydrants and joint details.

Affidavits, certifications, catalog and maintenance data shall be submitted per this section.

### **307.03 MATERIALS**

Fire Hydrant – 810.02

Gravel for Dry Well – Grading No. 57 aggregate per 803.02

Filter Fabric – Woven filter fabric shall be composed of polypropylene monofilament yarns woven into sheets of approximately sixteen (16) mil thickness. The tensile strength of the fabric shall be per ASTM D1682. The weave of the fabric shall be dense and tight so the openings are barely visible.

Test results shall indicate the filter fabric can effectively retain particles coarser per opening of U.S. 140-sieve mesh for all conditions.

Tests shall also demonstrate that the filter permeability is between 3.3 and 3.8 x 100 centimeters per second.

Filter fabric shall be manufactured by Mirafi Company, P.O. Box 240967, Charlotte, N.C. or approved equal.

### **307.04 CONSTRUCTION REQUIREMENTS**

Fire hydrant and dry well material, excavation, installation and backfill shall be included in this Section. Fire hydrant connection pipe excavation and backfill shall be included as part of trench excavation per 207.

All related work on hydrant water line including tests and chlorination shall be per applicable provisions of 305. Hydrants shall be set plumb with 4-inch nozzle normal to the curb line. When encountered, hydrant delivered with nozzle facing in the improper direction, District employees will rotate hydrant correctly when placing the hydrant into service.

Joint and joint restraint between boot and the connection pipe to the main shall be per 305.05(D) and (I).

Dry wells shall be excavated to dimensions as shown in the contract documents. Filter fabric shall be placed in the excavated dry wells' interior bottom, interior side walls and placed on the top of the excavation and secured around the hydrant's fittings before completing backfill.

Any items disturbed during construction, including shrubs and lawns, shall be restored by the Contractor upon completion of work. Grassed areas shall be resodded as part of work per 610.05.

**307.05 MEASURE AND PAYMENT**

The unit of measure will be each.

Payment for Set, Relocate, Adjust, Furnish and/or Convert Fire Hydrant will be made at the respective contract unit price per each, which payment will include property restoration and sodding, and all labor, materials, tools, equipment and incidentals needed to excavate, backfill and complete work specified.

The installation of a hydrant connection pipe, a gate valve and a water valve casing will be paid under other pay items.

## 308 WATER SERVICE CONNECTIONS

### 308.01 DESCRIPTION

[Refer to DC WASA Section 2650]

Where indicated in the contract, water service components to abutting properties shall be adjusted, replaced and/or maintained for water service connection piping 2-inches diameter and smaller, as needed to adapt water service connections to project requirements. Work includes water service trench excavation and fill per 207 and restoration of landscape features to original condition and sodding per 610.05.

Work shall be per this Section and the D.C. Plumbing Code and shall be performed by plumbers licensed in the District.

Related work specified elsewhere may include but is not limited to:

207: Trench Excavation and Backfill.

212: Test Pits.

305: Pipe Water Main – Ductile-Iron.

610.02: Sod and Sodding with 3-Inch Topsoil.

Quality Assurance – Reference Codes and Specifications:

American Society for Testing and Materials:

ASTM B88-96: “Seamless Copper Water Tube”.

ASTM D2146: “Specification for Propylene Plastic Molding and Extrusion Materials”.

ASTM D2853: “Standard Specification for Reinforced Olefin Injection Molding and Extrusion Materials”.

D.C. Plumbing Code.

#### PERMITS

Obtain Water Excavation Permits from the Department of Consumer and Regulatory Affairs for each water service connection to be adjusted or replaced. The cost of permits will be at the Contractor’s expense.

### 308.02 SUBMITTALS

No submittals are required for this work.

### 308.03 MATERIALS

Size No. 57 or 67 Gravel – 804.06

Seamless Copper Water Tube – 809.05(E)

Copper-to-Copper Couplings – Per D.C. Plumbing Code

Copper-to-Non-Copper Couplings – Per D.C. Plumbing Code – 3/4 inch through 2 inch diameter

Meter Yokes – Per D.C. Plumbing Code

Reducers – Per D.C. Plumbing Code

Angle Meter Stops – Per D.C. Plumbing Code

Meter Valves – Per D.C. Plumbing Code

Curb Stops – Bronze alloy with body and key precision fitted and lapped as a pair for a precision seal, inverted key or solid tee-head style. Mueller Inverted Key or Tee-Head curb stops are acceptable or approved equivalent.

Curb Stop Boxes – Curb stop boxes shall be of the telescoping, two piece, and screw style. The lower section shall consist of a full externally threaded shaft over a Buffalo style bell that is arched and flanged. The upper section shall consist of a full internally threaded shaft that fits over the lower section with a cast iron rim on top of the shaft accommodating a cast iron cover (lid) with “WATER” imprinted as specified.

Both the lower and upper section of the curb stop box shall be rigid acrylonitrile-butadiene-styrene (ABS) plastic, either injection molded or extruded per ASTM D1788, with test specimens molded by the injection process in accordance with Recommended Practice D1897.

The cast iron lid and rim shall be of the new standard Buffalo style design with standard pentagon head bolt and shall be interchangeable with the old style cast iron Buffalo boxes already in use.

The Series 250 Screw Type curb stop box made by Bingham & Taylor, Culpeper, Virginia is approved as an acceptable equivalent.

Meter Boxes – Meter boxes shall be of durable, high density polyethylene, molded with solid walls (containing no foam or corrugations) and shall have flanged bottom not only for added strength but also to retard settling or sinking into the ground. The nominal wall thickness of the box shall not be less than 0.3 inch and the box shall have nominal dimensions of 20 inches in diameter by 30 inches in depth. Other sizes may be used, if needed, for larger settings.

The polyethylene (PE) plastic material specified for the box shall be Type III or Type IV High Density polyethylene per ASTM D1248, with densities of 0.95 g/cc and above, as determined by the ASTM D1505 test method. The interior color of the box shall be white (natural) to aid in meter reading, but the exterior shall be black, compounded to improve strength and to protect against deterioration below ground. The low temperature brittleness shall be a maximum of (-76 degrees Fahrenheit) per ASTM D746. The vertical crushing strength, which is a measure of the magnitude of static vertical pressure a meter can withstand, shall be 3000 lbs. minimum.

A meter box such as MS 2030B, manufactured by Mid-States Plastics, Inc., Lexington, Kentucky, is acceptable or approved equal.

Meter box frames and covers to be used in conjunction with the meter boxes specified above shall be cast iron, Type A made by Meter Box Covers, or approved equal, having 1 1/2

inch clear openings with a bronze pentagon nut (standard size) swaged to an iron locking worm gear. The meter box frames and covers shall be made of gray cast iron treated with a coal tar epoxy coating and the covers shall be labeled with a "WATER METER" imprint as specified. A meter box frame and cover equivalent to MBC Model M3A, manufactured by Meter Box Covers, Inc., Waldorf, Maryland, is acceptable.

### **308.04 CONSTRUCTION REQUIREMENTS**

- (A) **NOTIFICATIONS.** Property owners/tenants shall be notified at least 48 hours in advance of the Contractor's intent to work in their front yards in public space and the Contractor shall assure owners that disturbed property will be restored to its original condition, as shown in preconstruction photographs, upon completion of work.
- (B) **WORK ON PRIVATE PROPERTY.** In general, most water service building connection work is in public space. The Contractor shall locate all existing water service piping and may be required to conduct some work on private property. The Contractor shall obtain written approval from property owners before disturbing any private property, and shall submit a copy of the approval to the Chief Engineer. The Contractor shall make no claim for any time delay associated with obtaining permission to work on private property.

The District assumes no responsibility for any work or trespass on private property.

- (C) **MAINTAINING WATER SERVICE.** Existing water service shall, in general, be kept in service until transfer connections are made. Existing water service will then be discontinued from the old water main, service pipe disconnected from the corporation cock on the old main by the Contractor or abandoned in place as directed, service pipe adjusted or replaced as specified herein and connected to the new main by the Contractor within the time limits specified herein.

The Contractor shall contact the Manager, Distribution Division, and (202)-612-3410 two (2) weeks prior to proposed scheduling of water service work. The Contractor shall coordinate his water service work with water main tap and any required meter relocation or new meter installation by the District.

No more than three separate shutoffs will be permitted for any single water service connection, and the duration of each shutoff shall not exceed two (2) hours, except in an emergency when the Chief Engineer will grant a time extension. The Contractor shall give sufficient, advanced written notice to the Chief Engineer, starting time and duration of proposed shutoff sufficiently in advance to provide for emergency water supply.

If the proposed shutoff time conflicts with essential consumer use, it shall be rescheduled to alleviate interference. The Chief Engineer will determine the action to be taken for essential consumer use requests.

Overtime, weekend and holiday work may be ordered by the Chief Engineer to promptly complete temporary and/or permanent water service.

- (D) **WORK BY DISTRICT.** The District (D.C. Water and Sewer Authority, Department of Water Measurement and Billing) will furnish and install D.C. meters at no cost to the Contractor. For privately owned meters (2-inch and smaller diameter water service

installed and owned by private parties), the District will either make the necessary adjustments or will make arrangements for the owner to do so. District work includes connecting the meter at couplings to the existing meter yoke or new meter yoke furnished and installed by the Contractor. The Contractor shall furnish and install pipe, couplings, meter housings, frame and cover and meter housing gravel foundation.

The District will make all new water service connection taps at the water main, and will make tap removals from old main where indicated at no cost to the Contractor.

Where any unmetered water service is encountered, meters will be installed in public space by the District of Columbia Water and Sewer Authority.

Wherever an existing meter is located on private property or inside the building, the District will relocate said meter in public space.

- (E) **PRECONSTRUCTION PHOTOS.** Two (2) preconstruction photographs shall be taken of each property where water service will be adjusted or replaced. These photographs are in addition to, and shall meet the same requirements of, 108.08. Views shall be taken as directed to show preconstruction existing conditions at each property within the area associated with the work.
- (F) **ADJUST WATER SERVICE PIPE.** Work consists of adjusting water service connection pipe due to new water main work that affects water service.

If existing water service piping is copper with not less than 1-inch diameter and enough slack exists in the piping, the existing piping shall be connected to the new main without replacing any piping.

However, if the Chief Engineer determines that slack is insufficient or pipe cannot be bent by approved means to meet new corporation cock, adjustment under this subsection will not be feasible and a section of pipe shall be replaced per subsection (I) herein.

Work consists of trench excavation as needed within the street including excavation, backfill and compaction for District work to abandon old tap and install new tap, per 207, adjusting existing 1-inch through 2-inch diameter copper service pipe to bring pipe to the connection point at new corporation stop in main, making connection at tap, backfilling and compaction. .

The backfilled street area shall receive Temporary Asphalt Patching per Section 409.

- (G) **REPLACE WATER SERVICE PIPE.** Work consists of replacing water service connection pipe in the vicinity of and/or due to new water main work and/or new sewer work. Work shall meet requirements of Standard Drawing 308.01.

If the existing water service piping is copper, is not less than 1-inch diameter, and slack in the existing piping is insufficient to connect it directly to the new main, or else pipe cannot be bent by approved means to meet new corporation stop, the Contractor shall cut the pipe at a point behind the curbline as directed, install a new single section of same size copper pipe between the corporation stop (tap) and existing pipe, and connect new-to-existing water service pipe with a compression coupling.

However, if the point where existing pipe is to be cut is within five (5) feet of the meter, unless otherwise directed by the Customer Service Manager, Meter Operations, (202) 612-3495, the entire length between the new main and the meter shall be replaced with copper pipe not less than 1-inch diameter; pipe shall be continuous with no joints, couplings or fittings. Existing copper piping, if 1-inch minimum, between meter and property line shall remain. No curb stop will be required.

If the existing water service piping is not copper, or is copper pipe less than 3/4-inch diameter, the Contractor shall replace the water service piping (with a single section of copper pipe not less than 1-inch diameter with no joints, couplings or fittings) from the new main to the meter, and from the meter to:

- (1) The property line, along with a curb stop and curb stop box at the property line, if there is no building projection (areaways, steps, porches, bay windows, etc.) into public space.
- (2) The face of building projection, along with a curb stop and curb stop box close to the face of projection, when projection occupies public space.

Replacement piping shall be the same size as piping replaced except that all existing 3/4-inch or smaller non-copper piping shall be replaced with 1-inch copper piping.

In such case where the new copper pipe between main and meter will be 1-inch diameter but existing service between meter and dwelling is lead or galvanized pipe, the District will provide a new 1-inch meter, and the Contractor shall install 1-inch copper pipe between meter and property line (or building projection) along with a curb stop, curb stop box and compression coupling and reducer at the property line.

Work consists of trench excavation of dimensions as directed to allow sufficient space for meter and meter box replacement per 207. and preparation of new meter pit subgrade and gravel foundation, tunneling where feasible under curb/gutter, copings, walks, etc., removal and disposal of old service pipe and fittings if needed and, otherwise, abandonment (crimp ends) of existing pipe in-place, removal of top section of curb stop and box if present and abandonment of lower portion, installing new pipe and new riser pipe, providing new meter yoke with meter stop or meter valves and couplings, new meter box, and new frame and cover, connections at meter yoke, making connection at tap, curb stop and property line, backfilling and compaction, restoration of surface features including sodding per 610.02 and incidental work to restore water service.

A curb stop box shall be set plumb over the curb stop so that the stop is centered within box. Top section of box shall be rotated so that box cover will be flush with finished ground surface. Backfill shall be carefully placed to avoid disturbance of curb stop or curb stop box.

Work includes any excavation, backfill and compaction for District work at tap.

If the District determines that a meter requires relocation or a new meter is needed, the Contractor shall cut service pipe at a location as directed, provide new pipe, meter yoke and couplings, meter ox, frame and cover, and coordinate work with meter installation by the District. If meter and housing adjustments in-place are needed, the Contractor shall furnish and install new pipe and couplings.

Work consists of trench excavation per 207 and preparation of new meter pit subgrade and gravel foundation, new pipe and couplings as needed to meter yoke and to reconnect service in old meter location, providing new meter yoke with meter stop or meter valves and couplings, connecting meter yoke to service piping, backfill and compaction, restoration of surface features including sodding per 610.02 and incidental work to restore water service, after District installation of meter.

- (H) RESTORATION.** Any items disturbed during construction including walls, fences, shrubs and lawns shall be restored by the Contractor upon completion of work. Grassed areas shall be resodded as part of work per 610.05.

Any paved areas removed within water service trench limits shall be patched with asphalt per 409.

### **308.05 MEASURE**

The unit of measure for Adjust Water Service Pipe will be each.

The unit of measure for Replace Water Service Pipe will be the linear foot.

The unit of measure for Furnish and Install Curb Stop/Curb Stop Box will be each.

The unit of measure for Furnish and Install Water Meter Box, Frame and Cover will be each.

### **308.06 PAYMENT**

Payment for Adjust Water Service Pipe will be made at the contract unit price per each, which payment will include excavation or tunneling as needed, including excavation to abandon old tap, adjusting service piping and connecting to new corporation stop in new main, backfill, compaction excluding Temporary Asphalt Patching which will be measured and paid separately), and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Replace Water Service Pipe will be made at the contract unit price per linear foot of pipe in place complete, which payment will include photographs, excavation, allowance of two linear feet for meter yoke, couplings and riser pipe when needed, backfill and compaction including backfill for meter pits and curb stop boxes (excluding Temporary Asphalt Patching, which will be measured and paid separately), replacing service piping, connections at corporation stop in new main, at water meter, at curb stop and at connection and reducer as needed to connect to existing service pipe at property line, and all labor, materials, tools, equipment and incidentals needed to complete work specified. Property restoration and sodding shall also be included if not included in Section 308.04 H. Payment will be based on pipe in place, whether in open cut or in tunnel.

Payment for Furnish and Install Curb Stop/Curb Stop Box will be made at the contract unit price per each combined unit complete in place, which payment will include curb stop, curb stop box and its adjustment, securing cover, leakage test, and all labor, materials, tools, equipment and incidentals needed to complete work specified. Trench excavation and backfill will be included in Replace Water Service Pipe work.

Payment for Furnish and Install Water Meter Box, Frame and Cover will be made at the Contract unit price per each, which payment will include furnishing and placing meter pit foundation gravel, furnishing and installing water meter boxes, frames and covers, coordination with District installation of meters and all labor, tools, materials, equipment and incidentals needed to complete the work specified. Property restoration and sodding shall also be included if required and there is no Adjust or Replace Water Service Pipe pay item.

## 309 SEWER MANHOLES

### 309.01 DESCRIPTION

[Refer to DC WASA Section 2705]

Work consists of excavation, backfill and compaction beyond trench pay limits, furnishing and placing manholes complete, either over existing or new sewers, including concrete base and manhole frames and covers. Manhole riser shall, in general, be constructed of precast concrete elements unless otherwise specified. Brick masonry may be used in lieu of precast riser units for conditions as approved by the Engineer.

Related Work specified elsewhere may include but is not limited to:

207: Trench Excavation and Backfill

314: Pipe Sewer

317: Sewer/Water Formwork Construction.

318: Reinforcing Steel – Sewer/Water Work.

320: Sewer/ Water PCC Construction.

Reference Codes and Specifications:

- (1)ASTM A48: “Standard Specification for Gray Iron Castings”.
- (2)AASHTO M91: “Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)”.
- (3)AASHTO M315: “Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets”.
- (4)AASHTO M199: “Standard Specification for Precast Reinforced Concrete Manhole Section”.

### 309.02 SUBMITTALS

Shop drawings per 105.02 shall be submitted for precast risers, cast-iron frames and covers.

### 309.03 MATERIALS

Reinforcing Steel – 812.02, Grade 60

PCC – 817, Class B

Manhole Bases – Unless otherwise specified, manhole bases shall be precast or cast-in-place reinforced PCC, set on a minimum six (6) inch depth of compacted gravel on undisturbed material. An acceptable steel ring form shall be used to form a groove for the tongue of the bottom precast riser section.

Inverts – Invert channels shall be formed of brickwork and/or Class B PCC conforming to the adjoining pipe sizes. Invert sides shall be smooth curves with longest possible radius tangent to adjoining pipe center lines. Depths of smaller pipes shall match 0.8 depth of the

main pipe. A one inch wash shall be provided from the inside edge of the manhole base to the edges of the shaped channels.

Precast Concrete Risers – 822.04

Manhole Brick – 806.01(A)

Manhole Steps – 822.07

Compression Seals – 807.06(B)

Manhole Entry Seals – Manhole pipe entry seals shall be equivalent to “Press Wedge II” gaskets manufactured by Press-Seal Gaskets Corp., Fort Wayne, Ind.; “A-Lok” gaskets manufactured by A-Lok Products Corp., Trenton, NJ; or Kor-n-Seal”, manufactured by National Pollution Control Systems, Inc., Nashua, NH.

Mortar – 806.05(B)(4) and (5)

Manhole Frames and Covers – 815.04

Nonshrink Grout – 806.05(F)

### 309.04 CONSTRUCTION REQUIREMENTS

- (A) **MAINTAINING SEWER SERVICE.** Existing sewer service shall be maintained at all times. The Contractor shall conduct his operations so as to maintain flows in existing sewers through the project area. This will require proper coordination between construction replacement or abandonment so as not to block existing sewers that are to remain in service.

When it is necessary to pump sewage while replacing and installing manholes, the material pumped shall be carried by means of an approved hose or other closed, watertight conveyor to the downstream sewer or manhole designated by the Engineer. Sewage shall not be allowed to flow onto or over the street surface. Overtime, weekend, and holiday work may be required at no additional District cost to promptly complete temporary and/or permanent sewer service.

- (B) **EXCAVATION/BACKFILL.** Excavation for manholes over all sewers shall be extended as needed beyond trench limits, and the excavation shall be maintained and shored as necessary for proper construction. After the manhole is complete and concrete and parging have cured, the remaining excavation shall be backfilled per 207; the portion of backfill beyond trench limits shall be included as part of Sewer Manhole work. For manholes over existing sewers, all excavation shall be included as part of Sewer Manhole work.
- (C) **CONCRETE MANHOLE SECTIONS.** Manhole bases shall be precast or cast-in-place reinforced concrete, set on a firm foundation. Flow channels and benches shall be shaped with brick; or concrete may be used as needed, with brick facing. Bases for new manholes shall be precast with base riser cast integral with base slab.

Manhole steps shall be built into the walls of manhole bases as shown in the contract documents, with step legs embedded 3-3/8 inches into the concrete. Before press-fitting

steps into inserts or drilled holes, concrete must have attained 2,500 psi minimum field strength.

When constructing a new manhole over an existing sewer, the manhole base shall be constructed around the existing sewer before cutting the sewer. Precast concrete riser with doghouse openings cast in the lower end shall be used as a base riser and fitted over existing pipe, except over PVC pipe.

Riser and base sections shall have cast or augured cut-outs of the required diameter for connections and outlet pipes; maximum size of cut-outs shall be equal to the outside pipe diameter plus four (4) inches. A clearance of at least nine (9) inches of concrete shall remain between adjacent connection and outlet pipe holes and between riser joints and holes in precast risers and bases. Lesser clearance will be considered only if additional reinforcing steel is provided and details are submitted for approval.

For manholes on sanitary and combined flow sewers 24-inches and smaller diameter, the Contractor shall install a lubricated, rubber gasket entry seal into the manhole wall to effect a watertight connection between the connecting sewer pipe and the manhole.

Entry pipes shall be cut flush with the inside wall of the manhole.

Two-inch diameter lifting holes spaced 180 degrees apart are permitted provided PVC or rubber plugs are installed to make manhole watertight after installation.

Manhole risers shall be constructed of precast concrete elements where feasible, otherwise of brick masonry. Risers and cone tops shall be furnished with manhole steps 12 inches on center. Manhole steps shall be aligned on vertical section of sidewall having no pipe entry, with step legs embedded 3-3/8 inches into the concrete.

After the precast concrete riser joints have been joined, the annular joint space remaining on the inside and outside of the precast riser joints shall be filled with mortar and the inside joint trowelled smooth.

Manholes shall have a precast slab or eccentric cone top with proper size access hole to accommodate the required frame and cover. Brick masonry shall be used to adjust the frame and cover to approved grade. Not more than 18 inches of brick shall be used unless approved by the Engineer.

- (D) BRICK MANHOLE SECTIONS.** Manhole brickwork shall be plumb except for the eccentric top section, true to line with level and accurately spaced courses, with each course breaking joint with the course below. Joints shall not be less than 3/8 inch nor more than 1/2 inch with a minimum of one header course to every six (6) stretcher courses. Each brick shall be placed with a full joint in a full bed of mortar, shoved up against adjacent brick so that the mortar rises between and completely fills vertical joint. Exterior surfaces of brick manholes shall be completely coated with a 1/2 inch mortar parging and made watertight. Brick masonry walls shall be nine (9) inches thick for standard manhole depth; when manhole depth exceeds 15 feet, brick wall thickness shall be increased to 13 inches below 15 feet elevation.

Brick masonry shall not be placed when the ambient air temperature is below 40 deg. F and when it appears probable that temperatures below 40 deg. F will be encountered before mortar can set, unless adequate approved means are provided for protecting the

work from freezing. Work shall be protected by heating and maintaining the temperature of the masonry materials at not less than 40 deg. F on both sides of the masonry for not less than 72 hours. Work with, or on, frozen materials are prohibited.

During hot weather, masonry shall be protected from direct rays of the sun. All finished work shall be covered and kept damp for a period of seven days after placement.

Mortar shall be freshly mixed for prompt use; no mortar shall be used after setting or beyond one hour after the addition of water. Retempered mortar and freeze preventive chemical additives are prohibited. The mixing machine, batch size, and mixing time shall be approved by the Engineer. When hand mixing is done, mixing shall be accomplished in a clean, leakproof, nonporous mortar box constructed for the purpose.

Proper size manhole steps shall be aligned on section of sidewall that is vertical to frame and cover, with step legs embedded 7-3/8 inches into the brickwork.

The Contractor shall furnish manhole frames drilled with two 3/4-inch diameter holes, 180 degrees opposed in frame flange. With frame in proper position at required grade, corresponding holes shall be drilled with a minimum of two (2) inches into the brick masonry upon which the frame sits. Steel dowels shall be inserted through these holes to prevent lateral movement of frames during backfill and paving operations. Dowels shall be No. 5 rebars, three (3) inches minimum length, or approved equivalent. A mortar bed shall be constructed around the frame flange.

Excavation shall be backfilled per 207.06.

- (E) **COMBINED CONCRETE/BRICK SECTIONS.** Where approved by the Engineer, manholes may be constructed from a combination of precast sections, brick masonry, and cast-in-place reinforced concrete. At the point where the different materials join, a watertight joint shall be provided that leaves interior walls straight and smooth.
- (F) **FIELD CUT PIPE ENTRY OPENINGS.** Field cuts in concrete sections of manholes shall be accomplished with proper tools. Unless otherwise approved, the outline of the proposed hole shall be clearly marked and shall be line drilled not more than five (5) inches apart. The hole shall be made smooth to receive the pipe entry seal and the pipe. Pipe entry seals shall be used when connecting a proposed sanitary or combined sewer of 24-inches and smaller diameter to an existing manhole. Non-shrink mortar shall be used to fill the void between entry seal and pipe. For storm sewer connections made in the field, the annular space around the connection pipe shall be filled with nonshrink mortar. Field cut entry holes will not be permitted in proposed manholes unless approved.

When precast manhole bases are used for sanitary or combined sewer applications, an approved resilient entry seal shall be cast in the base during manufacture.

Pipe entry holes in brick sections of existing manholes shall be made by carefully removing sections of brickwork.

- (G) **REPLACE MANHOLE INVERT.** Work consists of removing and replacing inverts in existing manhole to redirect sewage flow. New invert shall be per 309.03.

**309.05 MEASURE**

The unit of measure for manholes on sewers 48-inches diameter or less will be the vertical linear foot, with measure taken from sewer outlet invert to top of frame for manholes over existing or new sewers.

The unit of measure for manholes on sewers larger than 48-inches diameter will be the vertical linear foot, with measure taken from the top of the concrete base to the top of frame.

The unit of measure for the complete reinforced concrete base for manholes on sewers larger than 48-inches diameter will be each.

The unit of measure for replacing manhole invert will be each.

**309.06 PAYMENT**

Payment for Precast Sewer Manhole and Brick Sewer Manhole will be made at the respective Contract unit price per vertical linear foot, which payment will include excavation, shoring and backfill beyond trench pay width for manholes over new sewers; excavation, shoring and backfill for manholes over existing sewers; furnishing and placing precast or cast-in-place reinforced concrete manhole base on all sewers 48-inches diameter or less, precast or brick manhole risers, precast reinforced concrete slab or eccentric cone top, brick masonry to adjust manhole frames and covers to correct grades; furnishing and placing manhole frames and covers, furnishing and placing manhole steps, maintaining sewer service, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Reinforced Concrete Base for sewer manholes on sewers larger than 48-inches diameter will be made at the contract unit price per each, which payment will include excavation, shoring and backfill beyond trench pay width for manholes over new sewers; excavation, shoring and backfill for manholes over existing sewers; furnishing and placing reinforced concrete manhole base; furnishing and placing pipe that protrudes into the manhole base; furnishing and placing manhole steps; maintaining sewer service, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Replace Manhole Invert will be made at the Contract unit price per each, which payment will include removal of existing invert, reshaping new invert, disposal of unusable materials, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

## 310 CATCH BASINS AND CONNECTING PIPE

### 310.01 DESCRIPTION

[Refer to DC WASA Section 2720]

Work consists of excavation and backfill, disposal of excess excavated material, furnishing all materials and constructing various types and sizes of PCC catch basins and connecting pipe to manholes complete as shown in the contract documents or as directed.

Related Work specified elsewhere may include but is not limited to:

207: Trench Excavation

309: Sewer Manholes.

314: Pipe Sewer.

Reference Codes and Specifications:

- (1) AASHTO M111-03: "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- (2) AASHTO M170-02: "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe".
- (3) AASHTO M315-03: "Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe".
- (4) AASHTO M199-99: "Standard Specification for Precast Reinforced Concrete Manhole Sections".
- (5) ASTM A36: "Specification for Structural Steel".
- (6) ASTM A48: "Standard Specification for Gray-Iron Castings"
- (7) ASTM C33: "Specification for Concrete Aggregates".

### 310.02 SUBMITTALS

Shop drawings per 105.02 shall be submitted for reinforcing steel layout, reinforced concrete pipe, water seal casting, catch basin tops and catch basin frames and covers.

### 310.03 MATERIALS

Trench Excavation – 207

PCC Pipe – 808.01(B), Class III

Reinforcing Steel – 812.02, Grade 60

Cast-in-Place PCC – 817, Class B, except Class G for Pipe Cradle

Precast Basin Tops – 822.04

Joint Mortar – 806.05(B) (4)

Water Seal Castings/Basin Frames and Covers – 815.04

Steel Angles/Channels – 815.01(A)

Foundation Gravel – 804.06.

### **310.04 CONSTRUCTION REQUIREMENTS**

Excavation for catch basins and connecting pipe shall include removal of all materials and objects of whatever nature encountered in excavation, disposal of excavated materials as specified, construction, maintenance and subsequent removal of any sheeting, shoring and bracing, dewatering and precautions, and work necessary to prevent damage to adjacent properties resulting from this excavation.

No excavated material shall be deposited at any time so as to endanger portions of the new or an adjacent structure, either by direct pressure or indirectly by overloading banks contiguous to the operation, or in any other manner. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of construction. If the area within project limits is insufficient for stockpiling, the Contractor shall arrange for his own stockpiling area.

When the catch basin is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation; final removal of foundation material to subgrade shall be accomplished after forms are set.

If the foundation becomes wet and spongy or otherwise unsatisfactory prior to placing PCC, the Contractor shall, at no additional cost to the District, remove the unsuitable material and replace it with size No. 57 gravel per 804.06 to secure an adequate foundation.

In case of underground obstruction at planned locations, proposed basins or connecting pipe shall be relocated as directed. Excavations at obstructed locations shall be backfilled per 207. Payment for excavation and backfill at obstructed locations will be made per 207.

Inlets may be either cast-in-place or precast; precast basins require advance approval. Outlet pipe shall project from the inlet sufficiently to permit junction with connection pipe, and shall be cut flush with the inlet wall inside face; void between outlet pipe and wall shall be completely sealed on both sides of wall with non-shrink mortar. Water seal per 815.04 shall be aligned on same centerline as the outlet pipe.

If a catch basin is to connect to a combined system sewer, an approved water seal casting shall be installed in the basin wall, aligned on the same centerline as outlet pipe, and be connected to the inlet connection pipe.

Trench excavation and backfill for basin connecting pipe per 207 shall be included as part of work. If trench subgrade material is unsuitable, trench bottom shall be undercut and backfilled per 207.06(A), measured and payment made per 207.06(B).

All connecting pipe shall be included as part of work and shall be constructed as shown in the contract documents. All connecting pipe shall be furnished with rubber gaskets and the required concrete cradle with saddle blocks and mortar joints. Construction shall be per 314.04(D). Field leakage test is not required for storm drain pipe.

PCC Cradle shall meet the requirements for Class G PCC per 817.01. PCC shall cure for at least four (4) days prior to backfilling.

Where PCC pipe connects to existing clay pipe or to a water seal, a Class B PCC collar shall be constructed around the connection joint such that there is at least three (3) inches collar thickness around the entire circumference of the joint. The collar shall overlap each side of joint by six (6) inches. Collar shall cure for at least four (4) days prior to backfilling.

Connecting pipe trench shall be backfilled per 207.07(A).

Basin tops shall be precast with cast-iron frames and covers as shown on the contract documents and Standard Drawings.

The basin top shall have four (4) holes drilled or cast therein. Corresponding holes shall be drilled into the basin walls. Steel dowels shall be inserted through and into these holes and grouted to prevent lateral movement of top.

### **310.05 MEASURE AND PAYMENT**

The unit of measure for the various types and sizes of Catch Basins will be each.

The unit of measure for Basin Connecting Pipe will be the linear foot measured from the inside face of catch basin or water seal to inside face of manhole, or to connection to existing connecting pipe.

Payment for the various types and sizes of Catch Basins will be made at the respective Contract unit price per each, which payment will include water seal castings, frames and covers, excavation and backfill, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for 15-inch and 18-inch Basin Connecting Pipe will be made at the respective Contract unit price per linear foot, which payment will include excavation for pipe and backfill, saddle blocks and concrete cradle, concrete collars at connection to existing clay pipe, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

### **311 ADJUSTING MANHOLES AND ADJUSTING, REBUILDING AND REPLACING CATCH BASINS**

#### **311.01 DESCRIPTION**

Work consists of adjusting and resetting existing sewer manhole frames and water valve casings to approved grade, adjusting drop inlet frames, standard basin tops and elongation tops to approved grade, furnishing basin tops and manhole frames and covers to replace units made unusable from conditions beyond the Contractor's control, repairing and modifying various types of sewer structures and manholes, removal and disposal of excess materials.

Work includes adjusting or resetting, during emergencies only, existing PEPCO, Bell Atlantic (C&P), Gas Company, and Western Union utility manhole frames or similar structures to new grade; normally the respective utility will perform this work at no expense to the Contractor. If private utility manhole frames or covers are unusable from conditions beyond the Contractor's control, replacement units will be furnished by the respective utility company at no expense to the Contractor.

#### **311.02 MATERIALS**

PCC – 817, Class B

Precast PCC Manhole Rings – 822.04

Reinforcing Steel – 812.02, Grade 60

Brick – 806.01(A)

Steel Channels – 815.01(A)

Cast iron Frames, Covers – 815.04

Mortar – 806.05(B)(4) and (5)

Temporary Asphaltic Concrete – 407

Manhole Adapter Rings – 822.05(B)

#### **311.03 ADJUST MANHOLE FRAMES/DROP INLET FRAMES**

When an existing roadway is to be removed and rebuilt, water valve casing frames and sewer manhole frames shall be adjusted to proper grade either by the removal or addition of up to three (3) full courses of sewer brick, or precast ring plus brick, and/or two (2) precast PCC rings for water valve casings. Inlet frames shall be adjusted by removal and/or construction of inlet walls up to eight (8) inches high.

Manhole and inlet frames, grates and covers shall be removed, stored for reuse, and reset with mortar.

Work may also involve adjusting private utility frames in an emergency.

Payment for excavation and pavement replacement surrounding the frame will be made under applicable pay items.

Manhole frames adjusted in flexible pavement areas shall be provided with a PCC collar of sufficient horizontal dimensions to provide a minimum width of nine (9) inches outside the frame flange, square in section, and to a depth equal to the asphaltic concrete base being placed but not less than six (6) inches.

Payment for the PCC collar will be made under cubic yards of PCC Base with a minimum of 1/4 cubic yard of concrete allowed for each manhole.

#### **311.04 RESET MANHOLE FRAMES/DROP INLET FRAMES**

When the roadway is to be salvaged, work consists of resetting sewer manhole frames, water valve casing frames and storm inlet grate frames by cutting and removing a rectangular section of existing paving to provide nine (9) inches width between frame flange edge and cut line; adjusting frame to grade and soils for base if needed per 203.02; and furnishing and placing PCC base as a collar around adjusted frame to depth of existing base but not less than six (6) inches depth. Work includes resetting private utility frames during emergencies. Units damaged due to the Contractor's operations shall be replaced at the Contractor's expense.

When traffic must be maintained, steel plating per 616.19 placed over the reset frame shall be used as directed as part of work. Plates shall be maintained and removed when directed. They shall be of adequate size and positioned to provide bearing along each side of the plate of at least six (6) inches between plate edge and cut edge. If the plate deflection under traffic alters the frame position, repair shall be at the Contractor's expense.

#### **311.05 ADJUST STANDARD BASIN TOPS/ELONGATION TOPS**

Work consists of removing catch basin tops, cutting down basin and elongation walls not more than eight (8) inches as needed, mortaring and/or placing up to three (3) full courses of brick and reinstalling tops to meet approved line and grade and to provide firm, even bearing for tops.

#### **311.06 FURNISH INLET FRAME AND MANHOLE FRAME UNITS**

Work consists of furnishing storm inlet frame and grate units, basin tops of various size, and sewer-water manhole frame and cover units to replace units made unusable from conditions beyond the Contractor's control; work also includes furnishing water valve casing frames and covers to replace obsolete conic water valve frames encountered.

Placement of furnished units will be included in applicable adjust and reset pay items.

#### **311.07 MANHOLE ADAPTER RINGS**

Work consists of furnishing and placing cast iron adapter rings to bring manhole covers to approved grade. Rings shall be set just prior to placing asphalt pavement. Manhole cover seat of frame shall be cleaned just prior to setting ring.

Rings shall be either clamped or tack welded to the frame when improper seating is evident.

**311.08 REBUILD SEWER-WATER MANHOLES AND STANDARD BASINS**

Where the grade differential is such that manholes and standard basins cannot be adjusted or reset as directed in 311.04 and 311.05, they shall be rebuilt as follows:

Work under (A), (B) and (C) includes excavation and disposal of excess materials, furnishing of PCC, brick, PCC rings, reinforcement, and backfill and compaction as appropriate per 207 and other incidental work. Existing frames and covers shall be reused where practicable. Construction shall be in conformance with 302, 309 and 310.

- (A) **WATER VALVE CASINGS.** Where more than two (2) precast rings are required, additional rings shall be added and payment limit will be the bottom of the lowest PCC ring set. Construction shall be per 302.
- (B) **SEWER MANHOLES.** Where more than three (3) full courses of brick are required, or where a manhole is to be lowered, the manhole shall be removed to the bottom of the cone or tapered section, or lower if necessary. The manhole shall then be rebuilt to the new elevation, providing a full four (4) foot tapered section. Construction shall be in conformance with 309.
- (C) **STANDARD BASINS OR ELONGATIONS.** Where basin and elongation walls have to be cut down more than eight (8) inches, elongations shall be removed completely and replaced by double/triple basins, and existing basins shall be cut down and rebuilt with Class B concrete per 817 to new elevations as shown on the contract drawings or as directed.

**311.09 REPLACE BASINS**

Work consists of the complete removal of existing standard or elongated basins and the construction, in its entirety, of new double or triple basins at the same location. Work includes excavation and disposal of the existing basin and excess materials and construction of the new basin in accordance with 310 and backfilling.

When removing the existing basin, care shall be exercised to ensure that the connecting pipe entering the basin is not damaged. Pipe damaged due to the Contractor's operations and considered suitable for the final installation shall be replaced at his expense. Sections of connecting pipe deemed to be unsuitable for the final installation shall be replaced under the Basin Connect Pipe pay item per 310.

**311.10 MEASURE AND PAYMENT**

The unit of measure for items except Rebuild Sewer-Water Manholes and Rebuild Standard Basins and Elongations will be each. The unit of measure for Rebuild Sewer-Water Manhole will be the vertical linear foot, with measure taken from the lowest point of new construction to the top of the manhole frame. The unit of measure for Rebuild Standard Basin or Elongations will be the cubic yard with measure taken from the lowest point of new construction.

Payment for Adjust Manhole/Drop Inlet Frame, Reset Manhole/Drop Inlet Frame, Adjust Standard Basin Top/Elongation Top, Furnish Inlet Frame, Furnish Basin Top, Furnish Manhole Frame and Manhole Adapter Ring, will be made at the respective contract unit price

per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Rebuild Sewer-Water Manholes will be made at the contract unit price per vertical linear foot. Payment for Rebuild Standard Basins or Elongations will be made at the contract unit price per cubic yard which payment will include all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Replace Existing Basin with Double (or Triple) Basin and Replace Existing Basin with Double (or Triple) Type 'S' Basin will be made at the respective Contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete the work specified.

### 312 REPLACING SEWER/WATER MANHOLE FRAMES AND BASIN TOPS

#### 312.01 DESCRIPTION

- (A) **REPLACE SEWER AND WATER MANHOLE FRAMES.** Work consists of replacing damaged or deteriorated sewer or water manhole frames and concrete rings.
- (B) **REPLACE OLD STYLE (CONICAL SHAPED) WATER VALVE CASTINGS.** Work consists of the replacing of the old style (conical shaped) water valve castings, encountered within the project limits, with standard valve casing elements.
- (C) **REPLACE STANDARD BASIN TOPS.** Work consists of furnishing a new Standard Basin Top, when the existing top requires replacement due to damage not caused by the Contractor's negligence.

#### 312.02 MATERIALS

- Brick – 806.01(A)
- Mortar – 806.05(B) (4) and (5)
- PCC – 817, Class B
- Reinforcing Steel – 812.02, Grade 60
- Manhole Frames and Covers- 815.04
- Precast PCC Risers and Cone Tops – 822.04
- Rapid Setting Emulsified Asphalt – 802.05

#### 312.03 CONSTRUCTION REQUIREMENTS.

- (A) **REPLACE SEWER AND WATER MANHOLE FRAMES.** The method of construction shall be as specified in 311.

All new materials shall be furnished by the Contractor. Work includes replacing the cut out pavement with PCC base in accordance with 505.

- (B) **REPLACE OLD STYLE (CONICAL SHAPED) WATER VALVE CASTINGS.** Old style (conical shaped) water valve castings shall be removed and disposed of.
- (C) **REPLACE STANDARD BASIN TOPS.** Precast basin tops shall be constructed to the dimensions and details shown in the contract documents.

The method of construction shall be per 311.

#### 312.04 MEASURE AND PAYMENT

- (A) **REPLACE SEWER AND WATER MANHOLE FRAMES.** The unit of measure for Replacing Sewer and Water Manhole Frames will be each. Payment for frames furnished and placed will be made at the contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete work specified.

- (B) REPLACE CONICAL SHAPED WATER VALVE CASTINGS.** The unit of measure will be each. Payment for Conical Shaped Water Valve Castings replaced will be made at the contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete work specified. Payment includes replacement of pavement complete.
- (C) REPLACE STANDARD BASIN TOPS OR ELONGATION TOPS.** The unit of measure will be each. Payment for Basin Tops or Elongation Tops furnished and placed will be made at the contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete work specified.

## **313 ABANDONING SEWER FACILITIES**

### **313.01 DESCRIPTION**

Work consists of abandoning catch basins and storm inlets, and their connecting pipes, and sewer manholes either by removal, partial removal, bulkheading, or any combination thereof. Work includes excavation per 207, disposal of unusable materials, bulkheads, and backfill and compaction.

### **313.02 MATERIALS**

Brick – 806.01(A)

PCC – 817, Class B

Mortar – 806.05(B)(4)

### **313.03 CONSTRUCTION REQUIREMENTS**

Portions of catch basin connecting pipe, manholes, and storm inlets within three (3) feet below approved roadway sub grade shall be totally removed. Catch basins outside the roadway shall be totally removed to a level at least eight (8) inches below sub grade; all trash and debris in the storm inlet chamber shall be removed; the basin bottom shall be broken to provide drainage as directed. Portions of sewer facilities lower than three (3) feet below subgrade shall be abandoned in place. Open ends of abandoned sewer pipes and connecting pipes shall be bulk headed at manholes, at catch basins, and inlet chambers by either nine (9) inch thick masonry in 36-inch diameter and larger openings and nine (9) inch thick brick masonry or PCC of approved mix design per 817 in smaller size openings. Work includes backfill with embankment fill and its compaction to sub grade per 203. Abandoned manholes shall be backfilled with embankment fill. Usable pre-cast basin tops, manhole frames and covers, basin seal castings, and precast sewer manhole units shall be removed from abandoned utilities with care and reused or delivered to a designated District Property Yard as directed. Unusable items shall be included in disposal.

### **313.04 MEASURE AND PAYMENT**

The unit of measure for Abandoning Sewer Facilities will be each.

Payment for Abandon Basin Connecting Pipe, Abandon Sewer Manhole, and Abandon Storm Inlet will be made at the respective contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete work specified.

## 314 PIPE SEWER

### 314.01 DESCRIPTION

[Refer to DC WASA Section 2730]

Work consists of furnishing and placing reinforced PCC pipe and PVC pipe sewers, and all associated work for a complete operable pipe system.

Related Work specified elsewhere may include but is not limited to:

207: Trench Excavation and Backfill.

309: Sewer Manholes.

315: Pipe Sewer TV Inspection.

Reference Codes and Specifications:

- (1) AASHTO M6: "Fine Aggregate for Portland Cement Concrete".
- (2) AASHTO M80: "Coarse Aggregate for Portland Cement Concrete".
- (3) AASHTO M 170: "Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe".
- (4) AASHTO M 315: "Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets".
- (5) ASTM D3034: "Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings".
- (6) ASTM D3212: "Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals".
- (7) ASTM F679: "Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings".
- (8) ASTM – F789: "Specification for Type PS-46 Polyvinylchloride, (PVC) Plastic Gravity Flow Sewer Pipe and Fittings".
- (9) ASTM F794: "Poly (Vinyl Chloride) (PVC) Profiled Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter".

Trench excavation and backfill are separate pay items from sewer pipe work, except for reinforced basin connections (see 310).

### 314.02 SUBMITTALS

Shop drawings per 105.02 shall be submitted for pipe laying schedule, fittings, specials and bevel pipe.

### 314.03 MATERIALS

PCC Pipe – 808.01(B)

PVC Pipe – 808.02 (A)

Joint Mortar – 806.05(B) (4)

Pipe Bedding, Grading No. 57 – Table 803.02-1

### 314.04 CONSTRUCTION REQUIREMENTS

- (A) **GENERAL.** Trench excavation shall be per 207. If the actual trench width below a horizontal plane 1'-0" above top of pipe exceeds the trench design width per 207.05(A), pipe installation shall be contingent upon the Contractor's submission, and approval, of pipe design reevaluation.

The Engineer reserves the right to limit the amount of pipe laid in advance of backfilling, but in no case shall the amount exceed 100 feet for sewer work. Trench excavation shall be completed at least 25 feet in advance of pipe laying, except that at the end of a work day or at the discontinuance of work, the pipe laying may be completed to within five (5) feet of the end of the open trench.

The District will monitor all pipe manufacturing operations; the Contractor shall notify the Engineer sufficiently in advance of pipe manufacture to facilitate monitoring.

- (B) **MAINTAINING SEWER SERVICE.** Existing sewer service shall be maintained at all times. The Contractor shall conduct his operations so as to maintain sewer flows through the project area. This will require proper coordination between construction replacement and abandonment so as not to block the flow in existing sewers that are to remain in service.

When necessary to pump sewage while replacing and installing relief sewers, the material pumped shall be carried by means of an approved hose or other closed, watertight conveyors to the downstream sewer or manhole designated by the Engineer. Sewage shall not be allowed to flow into or over the street surfaces. Overtime, weekend, and holiday work may be required at no additional District cost to promptly complete temporary and/or permanent sewer service.

- (C) **PIPE BEDDING.** Gravel bedding material shall be placed to full trench width and specified depth for proper pipe installation. For pipe of 48-inches and larger diameter, gravel bedding material shall be compacted with an approved vibratory compactor to the satisfaction of the Engineer.

Pipe shall be accurately placed on bedding to line and grade and to uniform bearing throughout its length. After pipe sections have been jointed as specified, remaining bedding material shall be placed, leaving no voids, and compacted under and around sides of the pipe to specified limits; pipe alignment, grade and jointing shall not be disturbed.

- (D) **PIPE INSTALLATION – PCC PIPE.** Pipe shall be accurately placed to line and grade and supported uniformly throughout its entire length by the pipe bedding material. Bell holes shall be carefully excavated to provide total pipe bearing in bedding material. An approved pipe laying tee shall be used when placing pipe six (6) feet or longer in laying length. A pipe hoist, crane, or other suitable device shall be used in laying all pipes greater than 18-inches diameter. No lifting holes of any sort will be permitted in pipe.

After the pipe is aligned for coupling, the groove or bell of the preceding pipe and the spigot of the pipe ready to be coupled shall be liberally coated with an approved type of lubricant. The spigot end, with the gasket placed in the groove and relubricated after placement, shall be entered into the bell of the pipe already installed, making sure that

both pipes are properly aligned. The pipe shall be then forced “home” by the use of a wedge puller or other approved means. A wedge, if used, shall be placed at least three (3) pipe lengths back from the pipe being jointed. Before the joint is fully home, the position of the gasket in the joint shall be determined by means of a suitable feeler gauge. If the gasket is improperly positioned, the pipes shall be separated and the gasket repositioned, if undamaged; damaged gaskets shall be replaced. Each section of pipe shall be laid in such a manner as to form a close, concentric joint with the adjoining section and to prevent sudden offsets in the flow line. The maximum allowable joint opening shall be three-fourths (3/4) inch; any larger opening will be cause for rejection.

After the pipes have been joined, the annular joint space remaining on the inside and outside of the pipes shall be filled with mortar and the inside joint troweled smooth.

When laying straight sewer pipe to a curved line, the opening of a pipe joint shall be limited to not more than three-fourths (3/4) inch; beveled pipe shall be used in any case where it is necessary to exceed this limit, whether the drawings note this condition or not, at no additional cost to the District.

No sand, mud, mortar, concrete or other materials shall be allowed on the inside of the sewer. Upon completion, the sewer shall be left straight, clean, smooth, and acceptable in every respect. Concrete shall be allowed to set before backfilling or walking is allowed on the sewer, and care shall be taken not to disturb the pipe bedding and joints.

During suspension of the work at night or other times, a suitable stopper shall be placed in the last pipe section to prevent earth or other foreign matter from washing in.

After pipe has been installed as specified, pipe bedding material shall be placed and compacted under and around the sides of the pipes to the full specified thickness and height, care being taken so that no voids exist and that the alignment and the grade of the pipes are not disturbed.

The balance of the trench will be backfilled per 207.

- (E) PIPE INSTALLATION – PVC PIPE.** PVC pipe shall be handled with care to avoid severe impact blows, abrasion damage, gouging and cutting by metal surfaces or rocks, and never handled with individual chain or single cable, even if padded. Exposure to sources of heat or hot objects such as heaters, boilers, steam lines, and engine exhaust shall be avoided. Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. Handling techniques in cold weather require more care than during hot weather. Each pipe unit will be inspected for straightness and damage before being installed in the work. Defective pipe and fittings shall be removed and replaced with approved materials at no additional cost to the District.

After the first course of gravel pipe bedding is placed per 314.04(C) attention shall be given to carefully placing pipe and excavating for socket joints.

Assembly of the gasket joint shall be performed as recommended by the pipe manufacturer. All joint surfaces shall be cleaned immediately before joining; the bell and beveled spigot shall be lubricated with an approved lubricant, then carefully pushed into place. A suitable device shall be used to force the pipe sections together. Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the

spigot into the bell until it contacts the gasket uniformly; do not swing spigot into the bell. Generally, the spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion. If undue resistance to insertion of the end is encountered or the reference mark does not position properly, disassemble the joint and check the position of the gasket. If the gasket is twisted or pushed out of its seat, inspect components, repair or replace damaged items, clean components, and repeat the assembly steps. If gasket was not out of position, verify or correct the location of the reference mark. Relocate the reference mark if it is out of position.

To join field-cut pipe, the pipe end shall be prepared first; a square cut is required for proper assembly. The pipe can be easily cut with a hacksaw, handsaw, or a power hand saw with a steel blade or abrasive disc. The pipe shall be marked around its entire circumference prior to cutting to insure a square cut. Use a factory-finished beveled end as a guide for proper bevel angle, depth of bevel, plus the distance to the insertion reference mark. The end shall be beveled using a pipe beveling tool or a wood rasp to the correct taper. A portable sander or an abrasive disc may also be used to bevel the pipe end. Round off any sharp edges on the leading edge of the bevel with a pocket knife or a file, then assemble as stated above.

Because concrete does not bond to PVC pipe or fittings, only PVC adapters shall be used to connect to the various other types of pipe. In addition, only PVC caps or plugs shall be used to bulkhead the ends.

Pipe bedding material shall be carefully placed in four separate courses per Standard Drawing 314.04. Material shall not be dropped directly on the pipe. After the first course is placed to pipe grade, attention shall be given to carefully placing pipe and excavating for socket joints. Bedding grave shall then be placed around pipe haunch in second course to provide correct alignment. Then, third course and finally fourth course shall be placed and consolidated to avoid pipe deflection.

Compaction equipment shall not be used directly over pipe until sufficient backfill has been placed to insure that such equipment will not damage or disturb pipes, usually a minimum of 30-inches depth.

The balance of the trench shall be backfilled per 207.

**(F) LEAKAGE TESTS.** A leakage test shall be conducted on each completed section of all sanitary and combined sewer systems. Field leakage tests are not required for storm drain pipe.

**(1) AIR TEST.** Pipe sewer up to 42-inch diameter shall be tested with air under low pressure and will not be accepted by the District until the sewer retains the air for the specified time. Sewers over 42-inches diameter shall be air tested if approved test equipment is available per D.C. Water and Sewer Authority requirements. All tests shall be conducted in the presence of District representatives.

The Contractor shall have the test equipment supplier furnish the Engineer certification that actual test equipment to be used has been calibrated and is accurate. Tests shall not commence until the certification has been accepted.

All equipment and materials required to perform pressure air testing of sewers and all expenses in connection with such tests, except for equipment specifically

designated as being furnished by the District and District personnel engaged in the supervision of testing, shall be included as part of pipe sewer work.

Failure of leakage tests will require investigation and repair by the Contractor at no additional cost to the District.

The District will participate in one test and one retest, if required, of each specific section of sewer without charge to the Contractor. If additional retests are required, all costs of District personnel and equipment associated with the retesting will be deducted from the Contractor's final payment.

Before an air test is scheduled, all backfill shall be completed and trench dewatering methods discontinued. Sewers to be tested, including manholes, shall be thoroughly cleaned, free from all debris and shall be inspected for any water leakage sufficient to constitute a noticeable trickle or flow. Such leakage shall be corrected and eliminated prior to beginning the air test. Leakage tests shall be scheduled with the Engineer at least 48 hours in advance.

The air test shall conform to the following procedure:

Test plugs shall be furnished and installed within the pipe at each manhole and shall be securely braced.

If the pipe to be tested is expected to be below ground water table, a small diameter perforated vertical pipe shall be installed from the invert elevation of the sewer to the ground surface prior to backfilling, or a pipe probe shall be inserted by boring or driving into the backfill material adjacent to the invert elevation of the pipe, to determine the ground water level above the pipe invert immediately prior to air testing the sewer. All gauge pressures in the test shall be increased by the amount of this back pressure due to ground water submergence over the end of the probe.

All gauge pressures in the test shall be increased by the amount of this backpressure due to ground water submergence over the end of the probe.

Air shall be added slowly to the section of pipe under test until the internal air pressure is raised to 4.0 psig. The air temperature shall be allowed to stabilize for at least two minutes with the pipe subjected to an internal pressure of 4.0 psig by adding only the amount of air required to maintain this pressure. After the two (2) minute period, the hose and compressor shall be disconnected completely from the pipe being tested to assure that no additional air is added.

As a safety precaution, no one shall be allowed in manholes after the air pressure is increased in the sewer line. If the Engineer suspects that the test plug may be leaking, the pressure first shall be relieved before any adjustments are made to eliminate air leakage at the plug. The plug may be precoated with a soap solution to check the plug for leakage.

If the internal pressure decreases, the time required for the pressure to drop from 3.5 to 2.5 psig shall be observed and recorded. This time interval shall be compared with Table 314.04-1. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in the table shall be deemed to have failed the low pressure air test. A sewer that fails to pass this test shall be repaired

by the Contractor at no cost to the District. Following repairs, the sewer shall be retested per designated procedure.

The Engineer will prepare a report on the required form for each section of sewer tested. The report form shall be executed by the Contractor and submitted to the Engineer.

**(2)HYDROSTATIC TEST.** Sewers over 42-inches diameter and manholes shall be tested by the hydrostatic method if approved air test procedure is not available.

Leakage shall not exceed a rate of 100 gallons per inch diameter per 24 hours per mile of sewer.

All equipment and materials required to perform tests and all expenses in connection with such tests, except for District personnel engaged in the supervision of testing, shall be included as part of pipe sewer work.

Hydrostatic test shall conform to the following procedure:

Where ground water is encountered in the trench during construction and the water level is expected to be over the top of the sewer pipe, the completed and connected pipe shall be tested for infiltration leakage by the exact measurement of the amount of water entering it after the pumping of ground water has been discontinued for at least three (3) days.

Where the ground water level is expected to be below the top of the pipe and where the slope of the pipe between adjacent manholes will permit, the sewer shall be subjected to an internal pressure by plugging the pipe lower end and then filling the sewer and manholes with clean water to a height of two (2) feet above the top of the pipe. Upper end plugs may be needed as directed. Measurements will be made of the rate of leakage from the pipe by determining amount of water required to maintain the initial level of two (2) feet above the top of pipe. The Contractor shall provide water for this test by making arrangements with the Engineer.

Each manhole and appurtenance to the system shall be watertight within the foregoing leakage limit.

Repairs to all defects responsible for leakage shall be by the Contractor at no additional cost to the District.

### **314.05 MEASURE AND PAYMENT**

The unit of measure for Pipe Sewer will be the linear foot, with measure taken along the top of the pipe complete in place, measured to inside face of sewer manhole. If profiles are included in the Contract documents, they are approximate and any variation shall not be a basis of any claim for compensation above that provided by direct measure.

Payment for the various types, classes and sizes of Pipe Sewer will be made at the respective contract unit price per linear foot complete in place, which payment will include furnishing and placing required pipe, bedding, jointing, maintaining sewer service, leakage tests, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

**TABLE 314.04-1 AIR TEST  
MINIMUM HOLDING TIME IN MINUTES AND SECONDS REQUIRED FOR  
PRESSURE DROP FROM 3.50 TO 2.50 PSIG  
PIPE DIAMETER, 10-INCH THRU 36 INCH**

Length (Feet)	10	12	15	18	21	24	27	30	33	36
25	1:00	1:00	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56
50	1:00	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53
75	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00
100	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:11	15:35	“
125	2:18	3:18	5:09	7:26	9:55	11:20	“	“	“	“
150	2:45	3:58	6:11	8:30	“	“	“	“	“	“
175	3:13	4:37	7:05	“	“	“	“	“	“	“
200	3:40	5:17	“	“	“	“	“	“	“	“
225	4:08	5:40	“	“	“	“	“	“	“	“
250	4:35	“	“	“	“	“	“	“	“	“
275	4:43	“	“	“	“	“	“	“	“	“
and greater										
	4:43	5:40	7:05	8:30	9:55	11:20	12:45	14:11	15:35	17:00

**PIPE DIAMETER, 42-INCH THRU 108-INCH**

Length (Feet)	42	48	54	60	66	72	78	84	90	96	108
25	8:05	10:34	13:22	16:30	19:58	23:45	27:53	32:20	37:08	42:15	50:56
50	16:10	21:08	25:28	28:18	31:08	33:58	36:47	39:32	42:27	45:17	“
75	19:49	22:38	“	“	“	“	“	“	“	“	“
and greater											
	19:49	22:38	25:28	28:18	31:08	33:58	36:47	39:32	42:27	45:17	50:56

## **315 PIPE SEWER TV INSPECTION**

### **315.01 DESCRIPTION**

[Refer to DC WASA Section 2732]

Work consists of furnishing all materials, labor, supervision, and equipment for the television inspection of existing and new pipe sewers and building sewers.

Related Work specified elsewhere may include but is not limited to:

309: Sewer Manholes.

314: Pipe Sewer.

Quality Assurance:

Experience – Television inspection work shall be performed by a Contractor who is regularly engaged in work of the character required,

Equipment – All equipment, devices and tools required for the Contract shall be owned (or leased) and operated by the TV inspection contractor.

### **315.02 SUBMITTALS**

Before commencing work, the Contractor shall submit to the District for approval:

Specific documentation, information, and reference that the TV inspection contractor and the on-site supervisor for the work have had successful experience in similar work under similar conditions.

Detailed written descriptions, including pertinent supplemental drawings, literature, tables and other material, of equipment, methods, procedures and scheduling proposed for the work.

A television inspection log shall be maintained during the television inspection work. This log shall be on a printed form and shall include the following:

Job/work assignment number.

Date of inspection.

Location and identification of sewer section televised.

Size and type of pipe.

Length of sewer section televised.

Locations of all service connections.

Locations of all structural problems encountered such as cracked or broken pipe, offset or open joints, protruding service connections.

Sags (including length and estimated depth).

Incidence of root intrusion.

Areas where further cleaning is required.

Recommendation of lining requirement.

Locations of service connections shall be referenced by horizontal distance from identified manhole and circumferential position with respect to pipe axes.

A summary report shall be submitted to the Engineer within ten days of the conclusion of TV inspection work including copies of all television inspection logs. The report shall be neatly bound in a protective cover.

Cassettes shall be submitted to the Engineer within ten days of the conclusion of field work.

### **315.03 EQUIPMENT**

Television Inspection Equipment – 903.04

### **315.04 EXECUTION**

(A) **TV INSPECTION.** The interior of new pipe sewers and the interior of existing pipe sewers and building sewers shall be visually inspected as directed by means of closed circuit television in the presence of the Engineer.

Inspection for all sewers up through 36-inches diameter shall be performed by moving the camera through the line along the axis of the pipe in either direction at a uniform slow rate by remote means, stopping at each joint or defect to allow adequate evaluation by the Engineer. For sewers 42-inches diameter and larger, camera movement shall be on a “hand held” basis.

The Engineer shall have access to the television monitor and all other operations at all times. The Contractor shall provide space for two District personnel at the same time in the trailer.

Picture quality and definition shall be as approved by the Engineer. If unsatisfactory, the Contractor shall remove equipment, replace it with satisfactory equipment and repeat the inspection at no additional cost to the District.

The Contractor shall make visual (with audio) tape recordings of each sewer inspection. Date, station (distance from manhole) and manhole identification shall be visually displayed on the videotape at all times.

All points of interest including all obstructions, broken pipe and other problems shall be indicated via audio during inspection.

Throughout the television inspection activities, the District reserves the right to alter the speed at which the camera is moved through the sewer. Should the quality of the television picture fail to provide a clear view of the entire sewer, the Contractor shall make appropriate adjustments in his monitoring equipment or discontinue work until the Engineer agrees that an acceptable picture has been obtained. Telephones or other suitable means of communication shall be set up between the two winches and the control monitor to coordinate the work.

Should the camera become stuck in the sewer, the Contractor will be responsible for its removal at no additional cost to the District.

- (B) **SAFETY.** The Contractor is responsible for safety of personnel and the public during Contract period. The Contractor shall provide all devices, material and equipment necessary to assure the safety and health of personnel and the public.

### **315.05 MEASURE AND PAYMENT**

The unit of measure will be the job with no direct measure taken, or per linear foot as provided in the Schedule of Prices and the contract.

Payment for Pipe Sewer TV Inspection will be made at the contract lump sum price, or contract unit price per linear foot, as specified, which payment will include preparation of logs for all sections inspected, television equipment, and a complete video tape cassette of each section, and all labor, materials, tools, equipment, and incidentals needed to perform television inspection as specified.

## **316 BUILDING SEWER CONNECTIONS AND CLEANOUTS**

### **316.01 DESCRIPTION**

[Refer to DC WASA Section 2735]

Where indicated in the Contract or directed, building sewers from abutting properties shall be either replaced, extended, and/or reconnected to the public sewer to restore full permanent service. Work includes building sewer excavation, shoring, and backfill per 207, providing cleanouts, restoration of landscape features, furnishing and installing pipe, fittings and incidental work to restore full sewer service.

Work shall be per this Section and the D.C. Plumbing Code and shall be performed by plumbers licensed in the District. In case of discrepancy between this Section and the D.C. Plumbing Code, this Section governs.

Related Work specified elsewhere may include, but is not limited to:

314: Pipe Sewer.

315: Pipe Sewer TV Inspection.

610.02: Sodding.

Reference codes and specifications:

- (1) AASHTO M170-02: "Reinforced Concrete Culvert, Storm Drain and Sewer Pipe".
- (2) AASHTO M315-03: "Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets".
- (3) ASTM A74-98: "Cast Iron Soil Pipe and Materials".
- (4) ASTM C700-97: "Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated".
- (5) ASTM D2564-96a: "Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe System".
- (6) ASTM D2665-98: "Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings".
- (7) ASTM D3311-94: "Drain, Waste and Vent (DWV) Plastic Fittings Patterns".
- (8) D.C. Plumbing Code: BOCA Basic National Plumbing Code and DCMR 12B (District of Columbia Code Supplement of 1986).

General Design Criteria: Work shall be per contract documents and shall meet requirements of the District of Columbia Plumbing Code.

Permits: The Contractor shall obtain a "Water or Sewer Excavation Permit", from the Department of Consumer and Regulatory Affairs, for each address where excavation in public space is required for a building sewer connection and/or cleanout; District permits will be issued without charge to the Contractor.

**316.02 SUBMITTALS**

All PVC pipe and fittings shall be accompanied by a certification from the pipe supplier, per ASTM D 2665 and D 3311, which will be the basis of acceptance of PVC materials.

A similar certification shall accompany other pipe materials when requested.

**316.03 MATERIALS**

Polyvinyl Chloride (PVC) Pipe – 808.02 (C)

Cast-Iron Pipe – 809.03

Vitrified Clay Pipe – Vitrified clay pipe and fittings shall be used only as directed and shall meet requirements of 808.03, Extra Strength

Reinforced PCC Pipe – 808.01(B), Class III

**316.04 CONSTRUCTION REQUIREMENTS**

- (A) **GENERAL.** No taps of existing public sewers shall be made by the Contractor except under the supervision of the Chief Plumbing Inspector, his authorized assistant or the Engineer. Two weeks prior to proposed scheduling of building sewer connection work, the Contractor shall give written notice to the Plumbing Inspector, with a copy to the Engineer, stating time of proposed work. All such connections shall be certified in writing by the Inspector per D.C. Plumbing Code.

Joints must be made under dry conditions. If water is present, necessary steps shall be taken to dewater the trench.

Damaged pipe and joints will be rejected and shall be removed from the job site by the Contractor.

The Contractor shall exercise care to avoid damage to water service piping which is normally located above and in proximity to building sewer piping. The Contractor shall repair water services that are damaged by their operations at no cost to the District.

- (B) **WORK ON PRIVATE PROPERTY.** In general, building sewer connection work is in public space. The Contractor shall locate all building sewer piping and may be required to conduct some minor work on private property. The Contractor shall obtain written approval from property owners before disturbing any private property, and shall submit a copy of the approval to the Engineer. The Contractor shall make no claim for any time delay associated with obtaining permission to work on private property.

The District assumes no responsibility for any work or trespass on private property.

- (C) **PRECONSTRUCTION PHOTOS.** Two preconstruction photographs shall be taken of each property where building sewer connections will be replaced or extended, or cleanouts constructed. These photographs are in addition to, and shall meet the same requirements of, 108.08. Views shall be taken as directed to show preconstruction, existing conditions at each property within the area associated with this work.

- (D) MAINTAINING SEWER SERVICE.** Existing building sewer service shall, in general, be kept in service for the maximum time practicable. Disconnection and reconnection of building sewer and/or cleanout shall be accomplished within the time limits specified herein.

Existing service in the street sewer shall be maintained at all times. The Contractor shall conduct his operations so as to maintain flow in the existing sewer. This will require proper coordination for construction of new wye for building sewer connection.

The Contractor shall have suitable hose and flow control equipment available to plug, block, bypass and pump sewage around isolated building sewer and street sewer sections until permanent piping is complete and in service.

When necessary to pump sewage while installing wyes in existing sewers or while replacing or extending building sewer connections, material pumped shall be carried by means of approved hose or other closed, watertight conveyors to the downstream sewer or manhole designated by the Engineer.

In no case shall bypass pumping be permitted other than during hours when the Contractor is present at the site. Sewage diverted during these times shall be returned to the sanitary system and not discharged into storm sewers, streams or the traveled way.

No more than three separate service disruptions will be permitted during phases of work for any single building sewer connection, and the duration of each disruption shall not exceed two (2) hours, except in an emergency when the Engineer will grant a time extension. The Contractor shall give written notice to the Engineer, stating time and duration of proposed disruption sufficiently in advance to provide for emergency sewer service. If proposed disruption time conflicts with essential consumer use, it shall be rescheduled to alleviate interference. The Engineer will determine action to be taken for essential consumer use requests.

Overtime, weekend, and holiday work may be required at no additional District cost to promptly complete temporary and/or permanent sewer service.

- (E) HANDLING PVC PIPE.** PVC pipe shall be handled per applicable requirements of 314.04(E).
- (F) REPLACE BUILDING SEWER CONNECTION.** Work consists of replacing malfunctioning building sewer connections as well as those with service traps, and reconnecting to existing or new street sewers. Work includes excavation and shoring, backfill and compaction to grade per 207, removal and disposal of old building sewer pipe encountered, furnishing and installing new PVC pipe and fittings between property line and street sewer, making approved connections, restoration of surfaces, sodding per 610.02, and incidental work to restore sewer service. Work may include abandoning existing piping in place and constructing new piping in new trench.

Wye and cleanout will be paid under separate pay items.

Other piping materials shall be used only in special situations as directed.

Replacement building sewer piping shall be the same diameter as piping replaced unless otherwise shown on the Drawings. However, in no case shall the nominal pipe diameter

be less than four inches. Replacement building sewer pipe shall be laid to a minimum two percent (2) grade and approved by the Engineer prior to backfilling.

Routings for building sewer replacement shall comply with Section P-308.4.1 of the D.C. Plumbing Code with respect to clearances from lot lines and separation from water service.

Each replacement building sewer shall have a cleanout installed as near to the property line as practicable per Standard Drawing 316.01.

Unless otherwise approved or directed by the Engineer, the buildings sewer shall be connected to a wye-branch installed in the street pipe sewer.

All building sewer replacements shall extend from the street sewer to the property line if there is no building projection (areaways, steps, porches) into public space. If a building projection exists onto public space, the building sewer replacement shall extend to the face of the projection.

- (G) EXTEND/RECONNECT BUILDING SEWER CONNECTION.** Work consists of extending and connecting existing fully functional building sewer connections (no evidence of malfunction, no service traps, no cracks, breaks, sags in line, etc., as determined by the Engineer) to new street sewers. Work includes excavation and shoring, backfill and compaction to grade per 207; disconnecting building sewer pipe from old sewer, furnishing and installing extension pipe section, or removal of existing pipe to shorter length as applicable, using same type material for pipe as existing pipe, disposal of removed pipe and fittings, making approved connections; restoration of surfaces, sodding per 610.02, and incidental work to restore sewer service.

Building sewer piping shall be the same diameter as existing piping unless otherwise shown on the Drawings. However, in no case shall the nominal pipe diameter be less than four inches. Building sewer pipe shall be laid to a minimum two percent (2) grade and approved by the Engineer prior to backfilling.

Routings for building sewer piping shall comply with Section P-308.4.1 of the D.C. Plumbing Code with respect to clearance from lot lines and separation from water service.

Unless otherwise approved or directed by the Engineer, the building sewer shall be connected to a wye-branch which has been installed in the street pipe sewer.

- (H) ADD OR REPLACE STREET SEWER WYE.** When, in the course of replacing/extending/reconnecting a building sewer connection to a street sewer, it is found that a wye is not available at the location required in the street sewer for the new connection or existing wye is considered inadequate by the Engineer, the Contractor shall install a new wye.

The wye shall be of same material as the pipe sewer, and shall include the proper wye adapter. Concrete collars are not permitted on PVC pipe.

As an alternate to installation of a new wye and/or a wye of the same material as the pipe sewer, and when approved, a cast-iron wye thimble may be used to connect building sewer connection pipe to vitrified clay pipe sewer. Such connection shall include cutting

neat hole to proper size in pipe sewer, attaching thimble over hole with suitable seal, and securing thimble with a Class B PCC collar to rigidly connect thimble to pipe.

Thimbles are prohibited for connection to PVC pipe sewers; only PVC wye shall be used.

When approved, a cast-iron straight thimble may be used to connect building sewer connection pipe to concrete pipe sewer. Such connection shall include cutting neat hole to proper size in pipe sewer, inserting thimble in hole with suitable seal, and securing thimble with a Class B PCC collar to rigidly connect thimble to pipe.

- (I) ADD BUILDING SEWER CLEANOUT.** When existing building sewer connection is in satisfactory condition (no evidence of malfunction, no service traps, no cracks, breaks, sags in line, root intrusions, etc., as determined by the Engineer) but there is no cleanout, work consists of adding a wye and cleanout near property line per Standard Detail 316.01.

The cleanout-to-building sewer connection pipe wye shall be of the same material as the building sewer connection pipe.

Work includes excavation and shoring, backfill and compaction to grade per 207; furnishing and installing cleanout, fittings and screw plug, making approved connections; restoration of surfaces, sodding per 610.02, and incidental work to restore sewer service.

**(J) LEAKAGE TEST.** All equipment and materials required to perform leakage tests and all expenses in connection with such tests, except for District personnel engaged in the supervision of testing, shall be included as part of building sewer connection work.

Each replacement building sewer shall be plugged at point of connection with the street sewer and at property line, and filled with water and tested with not less than a ten foot head of water. The water shall be kept in the system for at least 15 minutes before the leakage test starts.

Leakage shall not exceed a rate of 0.0316 gallon per hour per ten feet of building sewer connection pipe.

Measurement by the Engineer will be made of the rate of leakage from the pipe by determining amount of water required to maintain the ten foot head of water for a period not exceeding one hour. The Contractor shall provide water for this test by making arrangements with the Engineer.

The pipe and cleanout shall be watertight within the foregoing leakage limit. Repairs to all defects responsible for leakage shall be by the Contractor at no additional cost to the District.

- (K) RESTORATION.** Any items disturbed during construction including walls, fences, shrubs, etc., including decorative driveways, sidewalks and patios (brick, stone or decorative concrete), shall be restored by the Contractor upon completion of work. Standard concrete and asphalt paved area shall be patched with asphalt per 409. Grassed areas shall be re-sodded per 610.02 as part of work.

**316.05 MEASURE AND PAYMENT**

The unit of measure for Replace Building Sewer Connection, Extend/Reconnect Building Sewer Connection and Add Building Sewer Cleanout will be the linear foot, with measurement made on actual length of new pipe in place complete excluding cleanout wye. Measurement will be made along vertical length of cleanout pipe to discharge end of cleanout wye.

The unit of measure for Add or Replace Street Sewer Wye or Thimble will be each.

Payment for Replace Building Sewer Connection will be made at the Contract unit price per linear foot, which payment will include excavation, shoring, backfill, compaction, restoration and sodding (excluding temporary asphalt patching, which will be paid separately), replacing or extending sewer connection pipe and jointing, leakage test, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Extend/Reconnect Building Sewer Connection will be made at the Contract unit price per linear foot, which payment will include excavation, shoring, backfill, compaction, restoration (excluding temporary asphalt patching, which will be paid separately), extending sewer connection pipe and jointing or shortening existing pipe section and jointing, leakage test, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Add or Replace Street Sewer Wye or Thimble will be made at the Contract unit price per each, which payment will include furnishing and installing wye or thimble, maintaining sewer service, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

Payment for Add Building Sewer Cleanout will be made at the Contract unit price per linear foot, which payment will include excavation, shoring, backfill, compaction, restoration and sodding (excluding temporary asphalt patching, which will be paid separately), installation of cleanout including wye and jointing, leakage test, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

## **317 SEWER/WATER PCC FORMWORK CONSTRUCTION**

### **317.01 DESCRIPTION**

[Refer to DC WASA Section 3100]

Work includes furnishing all labor, materials, equipment and incidentals required to provide formwork for all PCC structures as shown on Drawings and as specified herein.

Related Work specified elsewhere may include but is not limited to:

318: Reinforcing Steel – Sewer/Water Work.

319: Sewer/Water PCC Accessories.

320: Sewer/Water PCC Construction.

Reference Codes and Specifications:

- (1) ACI 347R: “Guide to Formwork for Concrete”.
- (2) ACI Special Publication Number SP-4: “Formwork for Concrete”.
- (3) ACI 117: “Standard Specifications for Tolerances for Concrete Construction and Materials”.
- (4) U.S. Commercial Standard CS-251.
- (5) U.S. Product Standard PS-1.

General Design Criteria:

- (6) Design formwork for vertical loads and lateral pressures per ACI 347R.
- (7) Design formwork system, which is adequately braced and has adequate strength and stability to ensure, finished concrete within specified tolerances.
- (8) When necessary to maintain specified tolerances, design camber into formwork to compensate for anticipated deflection and creep due to weight and pressure of fresh concrete.
- (9) Chamfer exposed external corners 3/4 –inch.
- (10) Concrete formwork drawings and calculations shall be prepared by or under the direction of a Registered Professional Engineer (P.E.) and shall bear his/her P.E. Seal. Forms shall be designed in accordance with the criteria specified herein.

### **317.02 SUBMITTALS**

Working drawings shall be prepared in accordance with 703.14(A) and (B) and submitted in accordance with 105.02.

### **317.03 MATERIALS.**

PCC Formwork – 703.14

Sewer/Water PCC Accessories – 319

**317.04 CONSTRUCTION REQUIREMENTS**

Formwork and falsework shall be placed in accordance with 703.14 and 703.16 and removed in accordance with 703.17.

**317.05 MEASURE AND PAYMENT**

PCC formwork will not be measured separately for payment; the cost thereof shall be included in the lump sum or unit price for PCC items of which it is a part.

**318 REINFORCING STEEL – SEWER/WATER WORK****318.01 DESCRIPTION**

[Refer to DC WASA Section 3200]

Work includes furnishing all labor, materials, equipment and incidentals required and installing all reinforcing steel required for the reinforcement of PCC, as shown on the Drawings and as specified herein.

Related Work specified elsewhere may include but is not limited to:

320: Sewer/Water PCC Construction.

Reference Codes and Specifications:

- (1) American Concrete Institute: ACI 315: “Manual of Standard Practice for Detailing Reinforced Concrete Structures”.
- (2) American Concrete Institute: ACI 318: “Building Code Requirements for Reinforced Concrete”.
- (3) ASTM A82: “Specification for Cold-Drawn Steel Wire for Concrete Reinforcement”.
- (4) ASTM A185: “Specification for Welded Steel Wire Fabric for Concrete Reinforcement”.
- (5) ASTM A615: “Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”.
- (6) CRSI: “Manual of Standard Practice for Reinforcing Concrete Construction”.

**318.02 SUBMITTALS**

Shop drawings shall be submitted in accordance with 704.03.

**318.03 MATERIALS**

Reinforcing Steel – 812.02, Grade 60

**318.04 CONSTRUCTION REQUIREMENTS**

Fabrication, protection and placement of reinforcing steel shall be performed in accordance with requirements of 704.04 through 704.08.

**318.05 MEASURE AND PAYMENT**

PCC reinforcement will not be measured separately for payment; the cost thereof shall be included in the lump sum or unit price for PCC items of which it is a part.

### 319 SEWER/WATER PCC ACCESSORIES

#### 319.01 DESCRIPTION

[Refer to DC WASA Section 3250]

Work includes furnishing all materials, labor, tools, equipment and incidentals required to make all joints tight in the concrete, as detailed in the Drawings and as specified herein.

Related work specified elsewhere may include but is not limited to:

318: Reinforcing Steel – Sewer/Water Work.

320: Sewer/Water PCC Construction.

Referenced Standards:

- (1) AASHTO M282: “Standard Specifications for Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete”.
- (2) AASHTO M153: “Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction”.
- (3) U.S. Army Corps of Engineers Specification CRDC572: “Specification for PVC Water Stop”.

#### 319.02 SUBMITTALS

Shop drawings (specification sheets) per 105.02 shall be submitted for products including names, sources and descriptions.

Samples of materials being used shall be submitted when requested by the Engineer.

#### 319.03 MATERIALS

Water Stops – 807.02(B)

Preformed expansion joint filler – 807.01(B)

Joint sealant – 807.02 (A) (2)

#### 319.04 CONSTRUCTION REQUIREMENTS

- (A) Footings, beams and slabs shall have no horizontal joints
- (B) Construction joints shall be placed and secured perpendicular to the face of the PCC section.
- (C) Defective joints and defective and improperly placed sealers and sealants shall be removed and reconstructed at Contractor expense.
- (D) Water Stops:
  - (1) Water stops for all joints, as indicated on the Drawings, shall be placed without bends but shall be continuous around all corners and intersections. Splices shall be

made by welding per manufacturer's recommendations, subject to Engineer's approval.

- (2) Make provisions to support and protect water stops during the progress of the work. Fabricate field joints in water stops per manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any joints.
  - (3) A sufficient number of ties shall be placed, as directed, to insure that water stops will remain in the required position during PCC placement.
- (E) Preformed Expansion Joint Filler:
- (1) Expansion joint filler shall be furnished as specified in 807.01(A). Laitance shall be removed and joint faces acceptably cleaned before placing preformed joint material.
  - (2) Joint filler shall be fastened to the inside of the bulkhead form with non-corrodible fasteners to secure a mechanical bond with PCC placed on both sides of the filler. Material shall be so placed that exposed edge is within 1/8 inch for a 1/4 inch joint, in order that filler material edge can be lightly ground to provide uniform sealant depth.
  - (3) Care shall be taken at all times to prevent any disturbance of or damage to the joint filler.
  - (4) Field splices shall be made per manufacturer's recommendations for total contact fit.
- (F) Joint Sealant:
- (1) Before sealing joint edges with sealant, all mortar, surface coatings, form coating, moisture, spalls, protrusions, dust, oil, grease, and frost shall be removed as approved by the Engineer by use of grinding, sandblasting, mechanical abrading, acid washing, or a combination of these methods to provide a clean, sound base for sealant adhesion. Heat shall be applied to dry out joints where required. Loose particles present or resulting from grinding, abrading or blast-cleaning shall be removed by blowing out joints with oil-free compressed air prior to application of primer or sealant. Where PCC has spalled or broken, an epoxy grout shall be used to repair the PCC to give a uniform width of joint. The epoxy shall be Engineer approved and shall be applied as directed by the manufacturer.
  - (2) No sealant shall be placed until at least 28 days after the PCC is placed. Polyethylene bond breaker tape of correct width and length shall be placed over the joint edge.
  - (3) Sealant shall be applied by experienced applicators in strict accordance with manufacturer's recommendations. Joint sealer shall be applied when the ambient temperature is between 60 degrees and 80 degrees F.
  - (4) All PCC joint faces to be sealed shall be primed with a primer recommended by the sealant manufacturer. The primer shall dry for the length of time recommended by the sealant manufacturer before applying the sealant. The sealant shall be placed before the primer has dried out, so that it will provide the proper bond. If the primer dries out, another prime coat shall be applied before placing the sealant
  - (5) Sealant shall be installed within the time limit specified. All material not used after this time shall be discarded.

- (6) The application, tooling and finishing of the sealant shall be as recommended by the manufacturer. Sealant surfaces shall be smooth and even.
- (7) Adjacent surfaces shall be cleaned free of sealant or soiling as the work progresses. Use solvent or cleaning agent as recommended by the sealant manufacturer. All finish work shall be left in neat, clean condition.

#### **319.05 MEASURE AND PAYMENT**

PCC accessories will not be measured separately for payment; the cost thereof shall be included in the Contract price for PCC items of which it is a part.

## **320 SEWER/WATER PCC CONSTRUCTION**

### **320.01 DESCRIPTION**

[Refer to DC WASA Section 3300]

Work includes furnishing all labor, materials, tools, equipment and incidentals required to place Portland Cement Concrete (PCC), forms, joints including waterstops, and miscellaneous related items including inserts, manhole steps and embedded items, and PCC finishing.

Related Work specified elsewhere may include but is not limited to:

317: Sewer/Water PCC Formwork Construction

318: reinforcing Steel – Sewer/Water Work

319: Sewer/Water PCC Accessories

Portland cement, fine aggregate, coarse aggregate, water and admixtures as specified shall be ready-mixed (transit-mixed) concrete produced per AASHTO M 157 and as specified herein. All constituents, including admixtures, shall be batched at a central plant, except as further specified herein.

Reinforced concrete shall be per ACI 301 and as specified herein.

Samples of constituents and of concrete as placed shall be subject to laboratory tests. All materials incorporated in the work shall conform to approved samples.

### **320.02 SUBMITTALS**

- (A) The Contractor shall submit, for approval by the Engineer, a report for each PCC mix design per 817.01.
- (B) The Contractor and PCC supplier shall each submit certification that materials for the Contract are from the same source as trial mix tested materials.
- (C) The Contractor shall submit, for approval by the Engineer, proposed methods for controlling PCC temperature.
- (D) Ready mixed PCC production facilities shall meet requirements of AASHTO M 157 and shall be certified by the National Ready Mixed Concrete Association. A copy of the “Certificate of Conformance for Concrete Production Facilities” shall be submitted to the Engineer prior to batching any PCC materials. Equipment shall conform to the Standards of the Concrete Plant Manufacturer’s Bureau and shall have a rating plate attached.
- (E) Truck mixers shall meet requirements of 905.02(A).

### **320.03 MATERIALS**

Portland Cement – 801.01(C)

Pozzolan – 801.05

Fine Aggregate – 803.01

Coarse Aggregate – 803.02

Water – 822.01

Admixtures – 814.04 and .05

Epoxy Bonding Compound – 822.08(B) (1)

### **320.04 MEASURING/MIXING**

Materials for PCC shall be measured in accordance with 703.04. Mixing PCC shall be accomplished in accordance with 703.05.

### **320.05 TESTING AND ACCEPTANCE**

Testing of PCC shall be in accordance with requirements of 703.06.

### **320.06 CONSTRUCTION REQUIREMENTS**

#### **(A) INSPECTION AND CONTROL**

(1)The preparation of forms, placing of reinforcing steel, conduits, pipes and sleeves, batching, mixing, transportation, placing and curing of concrete shall be at all times subject to the inspection of the Engineer.

(2)Control of the mix shall be as specified in 817.01.

#### **(B) FORMS**

Formwork shall be as specified in 703.14.

#### **(C) PLACING AND CONSOLIDATING**

PCC shall be placed in accordance with requirements of 703.08 and consolidated in accordance with requirements of 703.09. Requirements of 703.07 apply for adverse weather conditions.

#### **(D) REMOVAL OF FORMS**

Forms shall be removed in accordance with requirements of 703.17.

#### **(E) CURING AND PROTECTION**

PCC shall be cured and protected in accordance with requirements of 703.18.

#### **(F) PATCHING REPAIRS**

Patching, if required, shall be done in accordance with requirements of 703.19.

#### **(G) EPOXY BONDING OF PCC**

Where indicated in the contract documents, epoxy bonding of new PCC to existing PCC shall be done in accordance with requirements of 703.24.

#### **(H) CONCRETE FINISHES**

Finishing of exposed surfaces of PCC structures shall be finished in accordance with requirements of 703.19.

**320.07 MEASURE AND PAYMENT**

PCC work will not be measured separately for payment. The cost thereof, including incidental work and materials, will be included in the payment for the applicable PCC work.

## **321 PCC VALVE/VENTURI VAULTS**

### **321.01 DESCRIPTION**

[Refer to DC WASA Section 3310]

Work consists of excavation, backfill and compaction beyond trench excavation limits, disposal of excess material, furnishing and constructing reinforced PCC vaults complete with gravel base, piers, joints, armored seats for top slabs, sumps, steps, water stops, anchor bolts, stack risers, valve box extension, lifting inserts, and manhole frames and covers at locations indicated in the Contract documents and/or as directed.

Related Work specified elsewhere may include but is not limited to:

305: Pipe Water Main – Ductile Iron.

308: Water Service Connections.

319: Sewer/Water PCC Accessories.

326: Moisture-proofing PCC Valve/Venturi Vaults.

Reference Codes and Specifications.

- (1) AASHTO M105: “Standard Specification for Gray Iron Castings”.
- (2) AASHTO M31: “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”.
- (3) AASHTO M 91: “Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)”.
- (4) ASTM C361: “Standard Specification for Reinforced Concrete Low-Head Pressure Pipe”.
- (5) AASHTO M315: “Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets”.
- (6) AASHTO M 199: “Standard Specification for Precast Reinforced Concrete Manhole Sections”.
- (7) ASTM D1850: “Standard Specification for Concrete Joint Sealer, Cold Application Type”.

### **321.02 SUBMITTALS**

Shop drawings shall be submitted per 105.02 for reinforcing steel layout, cast-iron frames and covers, vault steps and anchor bolts for venturi vaults.

### **321.03 MATERIALS**

Reinforcing Steel – 812.02, Grade 60

Cast-in-Place PCC – 817, Class B

Precast Vaults – 822.04

Precast PCC Rings – Precast valve manhole rings and reducer rings shall be per 822.04. Precast manhole rings shall be cast with joint groove to receive compression seal.

“O-ring” Seals – 807.06(B)

Manhole Brick – 806.01(A)

Manhole Steps – 821.07

Manhole Frames, Covers and Sumps – Gray-iron castings for frames and covers shall be per 815.04. Castings for sumps shall be per AASHTO M105, Class 35B.

### **321.04 CONSTRUCTION REQUIREMENTS**

Precast rings may be used in lieu of brick stack risers; an adapter shall be provided in vault opening to receive precast unit.

Vaults shall be constructed per contract drawings.

Sumps shall be recessed to provide a flush surface between grate top and vault floor.

Manhole steps shall be cast into walls as indicated.

The bottom flange of manhole frame shall have two 3/4 inch diameter holes drilled or cast therein, directly opposite each other. Corresponding holes shall be drilled, a minimum of two inches deep, into the precast concrete ring or brick masonry upon which the frame sits. Steel dowels shall be inserted through and into these holes to prevent lateral movement of frame and cover during backfill operations. Dowels shall be #5 rebars, three inches minimum length. Brick masonry, not exceeding four inches vertical depth, may be used to adjust frame and cover to approved grade when riser stack consists of precast rings.

Equipment for the installation or extrusion of sealant into joint spaces shall be a heavy-duty air-operated pump, capable of continuously feeding the compound under pressure, and capable of completely filling the joint space without discontinuities and without the formation of voids or entrapped air. Joints shall be dry, cleaned of scale, dirt, dust, curing compound and foreign matter prior to application. Cleaning shall be accomplished in a neat workmanlike manner with suitable tool(s) designed for cleaning concrete joints. The joint sidewalls shall be sandblasted and blown clean of loose sand prior to sealant application.

Suitable bond breaker shall be placed in joint recess. Bond breaker shall be compatible with the sealant, and shall not adhere to the sealant. Avoid overfilling the joint space. Joints shall be filled in a neat workmanlike manner from flush to 3/16 inch below the adjacent surface.

Vaults shall be moisture proofed as specified in 326.

After curing, remaining excavated area around vaults shall be backfilled per 207.

### **321.05 MEASURE AND PAYMENT**

The unit of measure will be each complete.

Payment for PCC Valve/Venturi Vaults will be made at the contract unit price per each, which payment will include excavation and backfill beyond trench excavation pay limits, moisture proofing, steps, sumps, and all labor, materials equipment, tools, and incidentals needed to complete work specified.

## **322 PCC THRUST BLOCK**

### **322.01 DESCRIPTION**

[Refer to DC WASA Section 3315]

Work consists of excavation, backfill and compaction beyond trench excavation limits, disposal of excess material, furnishing all materials for and constructing reinforced PCC thrust blocks complete. Thrust blocks shall be constructed as shown in the Contract Documents to encompass H piles and water main so as to provide rigid anchorage.

Related Work specified elsewhere may include but is not limited to:

207: Trench Excavation and Backfill.

305: Pipe Water Main – Ductile Iron

317: Sewer/Water PCC formwork Construction.

Reference Codes and Specifications: None this section.

### **322.02 SUBMITTALS**

Shop drawings shall be submitted per 105.02 for reinforcing steel layout.

### **322.03 MATERIALS**

Reinforcing Steel – 812, Grade 60

PCC – 817, Class B

### **322.04 CONSTRUCTION REQUIREMENTS**

Thrust block shall be constructed as shown in the Contract Documents. PCC shall cure for a minimum of four days prior to backfilling. Backfill shall be per Section 207.

### **322.05 MEASURE AND PAYMENT**

Thrust Blocks will not be paid for separately, but are to be included in the price of the details where they are shown.

## **323 REINFORCED PCC COLLAR**

### **323.01 DESCRIPTION**

[Refer to DC WASA Section 3316]

Work consists of excavation, backfill and compaction beyond trench excavation limits, disposal of excess material, furnishing all material for and constructing reinforced PCC collars complete. Concrete collars shall be constructed as detailed in the Contract Documents to encompass sewers so as to provide a rigid watertight connection.

Related Work specified elsewhere may include but is not limited to:

207: Trench Excavation and Backfill.

314: Pipe Sewer.

Reference Codes and Specifications: None this section.

### **323.02 SUBMITTALS**

Shop drawings shall be submitted per 105.02 for reinforcing steel layout.

### **323.03 MATERIALS**

Reinforcing Steel – 812.02, Grade 60

PCC – 817, Class B

Sewer/Water PCC Construction – 320.03

### **323.04 CONSTRUCTION REQUIREMENTS**

PCC collar(s) shall be constructed per applicable requirements of 320, per Standard Drawing 323.01 and as shown in the Contract documents. PCC shall cure for a minimum of four days prior to backfilling. Backfill shall be per 207.

### **323.05 MEASURE AND PAYMENT**

The unit of measure will be each.

Payment for PCC Collar (Reinforced) will be made at the Contract unit price per each, which payment will include furnishing and forming Class B PCC, furnishing and placing reinforcing steel complete, backfilling and all labor, materials, tools, equipment and incidentals needed to complete work specified.

## **324 PCC IN-LINE THRUST BLOCK**

### **324.01 DESCRIPTION**

[Refer to DC WASA Section 3317]

Work consists of excavation, backfill and compaction beyond trench excavation limits, disposal of excess material, furnishing all materials for and constructing reinforced in-line PCC thrust blocks complete. In-line thrust blocks for water mains 12-inch and larger shall be constructed as shown on the Contract Documents.

Related Work specified elsewhere may include but is not limited to:

207: Trench Excavation and Backfill.

305: Pipe Water Main – Ductile Iron

317: Sewer/Water PCC formwork Construction.

Reference Codes and Specifications: None this section.

### **324.02 SUBMITTALS**

Shop drawings shall be submitted per 105.02 for reinforcing steel layout.

### **324.03 MATERIALS**

Reinforcing Steel – 812.02, Grade 60

PCC – 817, Class B

Sewer/Water PCC Construction – 320

### **324.04 CONSTRUCTION REQUIREMENTS**

In-line thrust blocks shall be constructed as per applicable requirements of 320 and as shown in the contract documents. PCC shall cure a minimum of four days prior to backfilling. Backfill shall be per Section 207.

### **324.05 MEASURE AND PAYMENT**

The unit measure will be each.

Payment for PCC In-Line Thrust Block will be made at the contract unit price per each, which payment will include excavation beyond the trench excavation limits; forming, furnishing and placing reinforcing steel, complete in place, furnishing and placing follower glands to anchor in-line thrust block, furnishing, placing and curing PCC, backfilling and all labor, materials, tools, equipment and incidentals needed to complete work specified.

**325 NON-SHRINK GROUTING****325.01 DESCRIPTION**

[Refer to DC WASA Section 3600]

Work includes furnishing all labor and material required to perform the grouting specified on the Drawings or in the Specifications.

Related Work specified elsewhere may include but is not limited to:

317: Sewer/Water PCC formwork Construction.

318: Reinforcing Steel – Sewer/Water Work.

319: Sewer/Water PCC Accessories.

320: Sewer/Water PCC Construction.

Acceptable Manufacturers:

(1) U.S. Grout Corporation.

(2) Master Builders.

(3) USM Corporation.

(4) W.R. Meadows

(5) Sonneborn-Contech

Applicable Codes, Standards and Specifications:

(6) American Society for Testing and Materials (ASTM).

(7) U.S. Corps of Engineers (CRD).

**325.02 SUBMITTALS**

The Contractor shall furnish recent independent laboratory tests showing compliance with requirements specified. Certification or affidavits will not be acceptable.

The Contractor shall furnish manufacturer's literature describing product and instructions for use.

Applicable shop drawings showing grouting details shall be submitted per 105.02.

**325.03 PRODUCT DELIVERY, STORAGE AND HANDLING**

Grout shall be delivered in moisture proof bags with the manufacturer's name, product name and general instructions for placement printed on the bag.

Product shall be stored on pallets and protected from damage.

**325.04 MATERIALS**

Non-Shrink Grout – 806.05(F)

**325.05 CONSTRUCTION REQUIREMENTS**

- (A) **PREPARATION.** All contact surfaces shall be prepared in accordance with manufacturer's recommendations.

Grout contact surfaces shall be cleaned of all oil, grease, scale and other foreign matter.

Unsound concrete shall be removed leaving surface level but rough.

Concrete contact area shall be saturated with water 12-24 hours prior to grouting. Before placing grout, remove all excess or free standing water.

- (B) **MIXING.** Grout shall be mixed in strict accordance with the manufacturer's written instructions. Amount of water used should be a minimum quantity to provide the desired grout consistency. Mix only that quantity of grout that can be placed within 30 minutes after mixing.

- (C) **GROUTING.** All work shall be done in strict accordance with the manufacturer's recommendations, including special procedures for hot and cold weather grouting.

At the request of the Engineer, the manufacturer's representative shall be called to the job-site for consultation regarding detailed use of the grout.

The grout shall be placed using the most practical method, completely filling the space to be grouted and shall be thoroughly compacted and free of air pockets.

Do not remove forms until after the grout has taken an initial set and will not slump. After removal, cut off excess grout and finish to a smooth surface.

Prevent rapid loss of water from the grout during first 48 hours with the use of an approved membrane curing compound, or with the wetted burlap method.

**325.06 MEASURE AND PAYMENT**

Non-shrink grout will not be measured separately for payment; the cost thereof shall be included in the lump-sum or unit price for PCC items of which it is a part.

## 326 MOISTUREPROOFING – PCC VALVE/VENTURI VAULTS

### 326.01 DESCRIPTION

[Refer to DC WASA Section 7100]

Work consists of furnishing and applying all materials required to provide a protective coating and moisture barrier for cast-in-place and precast PCC vaults as indicated on the Drawings and as specified herein.

Related Work specified elsewhere may include but is not limited to:

320: Sewer/Water PCC Construction.

321: PCC Valve/Venturi Vaults.

Quality Assurance:

Moisture proofing work shall be performed by a contractor who is regularly engaged in work of the character required and in the application of materials specified herein.

Applicators of the materials specified shall be certified by the manufacturer.

### 326.02 SUBMITTALS

The following shall be submitted:

Manufacturer's literature describing product and detailed instructions for use.

Manufacturer's certification of compliance.

Certification of applicators.

### 326.03 MATERIALS

Emulsified Asphalt – 802.08

### 326.04 CONSTRUCTION REQUIREMENTS

- (A) **DELIVERY/STORAGE.** Materials shall be delivered to the work site (either precast vault manufacturer's site or job site) in the original unbroken packages or containers bearing the manufacturer's brand or label. The kind of material and the purpose for which it is to be used shall be indicated on the label.

Materials shall be handled and stored at the site in a place and in a manner so as to protect adequately the contents from damage, deterioration and contamination.

Storage space shall be kept clean at all times and every precaution shall be taken to avoid fire hazards.

All materials shall be stored at the temperatures recommended by the manufacturer.

- (B) **INSPECTION.** Prior to the application of any moisture proofing materials, the Contractor shall inspect surfaces to receive the moisture proofing specified and notify the

Engineer in writing of any serious defects or conditions that will interfere with or prevent a satisfactory installation.

Moisture proofing shall not be applied until all concrete work to receive moisture proofing has cured.

- (C) **SURFACE PREPARATION.** All PCC vault exterior surfaces shall be smooth and free from projections or holes.

All PCC surfaces to be moisture proofed shall be thoroughly cleaned by water jet, light sand-blast, or combination thereof.

(1) All surfaces shall be free from frost, dust, sand, laitance, mud, mortar and other loose particles.

(2) All grease spots or marks of oil shall be removed.

All voids, form tie holes, cracks, honeycomb or other imperfections in surfaces which, in the opinion of the Engineer and/or the material manufacturer's representative may cause leaks shall be routed out and patched prior to the installation of the moisture proofing system. Patching materials shall be as recommended by the vault manufacturer.

All joints in the PCC shall be prepared as recommended by the vault manufacturer.

- (D) **APPLICATION.** All materials shall be installed in strict accordance with the printed instructions of the manufacturer.

For cast-in-place vaults, apply to all exterior PCC surfaces of vault walls and top slab. For precast vaults, apply to all exterior surfaces.

Apply by brush or spray to give an even coat at rate of 2.5 gallons per 100 square feet, without rundown. Each joint area shall receive a second coat for a distance of nine inches each side of joint.

- (E) **CURING AND BACKFILLING.** Moisture proofing shall cure properly before precast vaults are placed in the ground.

All areas that have been moisture proofed shall have cured properly before backfilling starts.

Backfill shall be placed in a manner that avoids damage to the moisture proofing system.

### **326.05 MEASURE AND PAYMENT**

Moisture proofing will not be measured separately for payment. The cost thereof shall be included in payment for PCC Valve/Venturi Vaults.

## 327 SIDEWALK INTERCEPTOR DRAINS, CONNECTIONS, GRATINGS AND TRAPS

### 327.01 DESCRIPTION

- (A) **SIDEWALK INTERCEPTOR DRAINS.** Work consists of the construction of sidewalk interceptor drains at the entrances to service stations, garages, or other similar places where it is necessary to relocate existing drains due to roadway construction. They shall be constructed to the dimensions and at the locations as shown in the contract documents, or as directed by the Engineer.
- (B) **CAST IRON DRAIN CONNECTIONS.** Work consists of making the necessary connections for sidewalk intercept drains for service stations and/or garages to intercepting traps and/or existing or proposed storm sewers, and reconnecting rain leaders to the curb, where these connections or reconnections are due to roadway construction.
- (C) **CAST IRON GRATING REPLACEMENTS.** Work consists of replacing cast iron gratings in garage and/or interceptor drains that are broken during construction operations. They shall conform in size and dimensions as closely as possible to the existing grating.
- (D) **GARAGE INTERCEPTING TRAPS.** Work consists of constructing concrete garage intercepting traps to the dimensions and at the locations as shown on the contract drawings.

### 327.02 MATERIALS

Steel/angle iron – 815.01(A)

Ductile Iron for gratings – 815.05

Cast Iron Soil Pipe – 809.03

PCC – 817, Class B

Mortar – 806.05(B)(4)

### 327.03 CONSTRUCTION REQUIREMENTS

- (A) **SIDEWALK INTERCEPTOR DRAINS.** Work shall be done in strict conformance with applicable provisions for PCC construction of these specifications and the Plumbing Code of the District of Columbia with the following exceptions:

The bottom of the concrete drains shall be placed on the existing, undisturbed ground or the prepared, compacted fill neatly graded to the required elevation and dimensions as shown on the contract drawings. Excavations shall be per 207 and kept dry for the placing of concrete. The drains shall be placed as soon as practicable after excavation is complete to grade.

All vertical faces of PCC shall be formed. Forms shall be mortar tight, securely braced and tied to prevent movement and shall remain in place for at least 24 hours after PCC is placed.

PCC shall be consolidated by continuous working with tools and/or spud vibrators meeting the requirements of 905.07(B) during and immediately after placement in the forms. The vibration shall be of sufficient duration to consolidate the PCC but shall not be continued so as to cause segregation.

The angle iron frame for the grating shall be inserted in the PCC to the desired elevation when the PCC is still sufficiently plastic to do so without disturbing the forms or the top surface of the PCC drain.

The cast iron outlet pipe shall extend through the wall a sufficient distance to permit proper connections from the outside and cut flush with the inside wall. The area around the pipe shall be completely and neatly sealed with mortar.

The exposed sides of all angle irons shall be painted with one coat of primer paint and two coats of black paint prior to placement in the PCC. Painting shall be done as specified in 707.

- (B) **CAST IRON DRAIN CONNECTIONS.** The intercept drain connections and the drain leader connections shall be constructed in accordance with the D.C. Plumbing Code.
- (C) **CAST IRON GRATING REPLACEMENTS.** Work shall be in accordance with the D.C. Plumbing Code.
- (D) **GARAGE INTERCEPTING TRAPS.** PCC garage intercepting traps shall be constructed on existing, undisturbed ground or on prepared, compacted fill, neatly graded to the required elevation and dimensions as shown on the contract drawings. Excavation shall be per 207 and kept dry for the placing of concrete. The work shall be done in accordance with the D.C. Plumbing Code.

All vertical faces of the walls shall be formed. Forms shall be mortar tight, securely braced and tied to prevent movement and shall remain in place for at least 24 hours after PCC is placed.

Inlet and outlet pipes and fittings shall be inserted through the forms at the plan elevations and securely anchored to prevent their being dislodged while concrete is being poured.

PCC shall be placed as per 320.

#### **327.04 MEASURE AND PAYMENT**

- (A) **SIDEWALK INTERCEPTOR DRAINS.** The unit of measure will be the linear foot. Measurements will be made along the top surface of the drain out to the end walls. The actual number of linear feet of Sidewalk Interceptor Drain installed will be paid for at the contract unit price per linear foot, which payment will include excavation, disposal of surplus material, backfilling, compacting, furnishing, hauling, and placing all materials, including angle iron frame with anchors welded to it, setting existing or new grates in place, forming, painting, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.
- (B) **CAST IRON DRAIN CONNECTIONS.** The unit of measure will be the linear foot. The actual number of linear feet of Cast Iron Drain Connections of each size, measured

complete in place, will be paid for at the contract unit price per linear foot, which payment will include excavation, disposal of surplus material, backfilling, furnishing, hauling, and placing all materials including fittings, doing all jointing and connecting, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

- (C) **CAST IRON GRATING REPLACEMENTS.** The unit of measure will be the linear foot. The actual number of linear feet of Cast Iron Grating Replacements, measured complete in place, will be paid for at the contract unit price per linear foot, which payment will include furnishing, hauling and placing the grating, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.
- (D) **GARAGE INTERCEPTING TRAPS.** The unit of measure for Garage Intercepting Traps will be the cubic yard. The actual number of cubic yards of PCC determined from plan dimensions, will be paid for at the contract unit price per cubic yard, which payment will include one section of the inlet pipe and the necessary straight and 1/4 bend pipes to complete the goose-neck or water seal of the outlet pipe, all jointing and connecting, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

Deductions will not be made for the volume of inlet and outlet pipes.



## **DIVISION 400 ASPHALT CONSTRUCTION**

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**401 PLANT MIX PAVEMENTS – GENERAL**

**401.01 DESCRIPTION**

These specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

This work shall consist of furnishing, mixing, and placing materials for bituminous concrete pavements. Construction with bituminous mixtures shall meet these specification requirements and shall meet the requirements for the type of bituminous mixture as designated on the plans or in the special provisions. Materials shall be placed to the depth, grade, and cross section shown in the contract documents and/or as directed by the Engineer.

**401.02 COMPOSITION OF MIXTURES**

The bituminous plant mix shall be composed of a mixture of fine and coarse aggregate, mineral filler, bituminous material, and strip additive or hydrated lime and other additives when required.

**TABLE 401.02  
JOB MIX TOLERANCES FOR MIXTURE AND FINE AGGREGATES**

DESCRIPTION	MAXIMUM TOLERANCE (+ or -)
SIEVE SIZE, Percent Passing by Weight (inclusive), AASHTO T 30	
No. 4 and larger	7
No. 10 to No. 50	6
No. 80 to No. 100	4
No. 200	2
BITUMEN CONTENT, Percent by Weight	
AASHTO T 308	0.40
HYDRATED LIME	0.20
SOFTENING AGENT	0.20
LIQUID ANTI STRIP ADDITIVE	0.20

A job mix formula shall be submitted and approved in conformance with 818.01 prior to use.

The job mix formula shall remain in effect until a revised formula is submitted and approved or the formula is changed by the Chief Engineer.

Results of single tests per 500 tons or fraction thereof of bituminous mixture for gradation and bitumen content shall meet the approved job mix formula and shall not exceed the tolerances of Table 401.02 and shall be within the total job mix tolerances specified in 818.02. Tolerances for delivery temperature shall be + or – 25°F but shall not exceed the temperature limits specified in 818.02.

**401.03 MATERIALS**

Approval of the sources of supply and acceptance of the materials that are proposed for use shall be obtained prior to starting the construction, and in accordance with 106.

The materials for bituminous pavements shall be of the grade and type specified for the mixture designated and shall meet the following requirements:

Asphalt Cement – 802.02

Coarse Aggregate – 803.04

Fine Aggregate – 803.03

Mineral Filler – 803.05

Cut-back Asphalt – 802.04

Emulsified Asphalt – 802.05

Hydrated Lime – 822.03(A)

Liquid Anti Strip Additives – 802.07

Softening Agent – 802.06

**401.04 WEATHER AND SEASONAL RESTRICTIONS**

Bituminous concrete mixes shall not be placed at certain times of the year as indicated in Table 401.04 or when the surface temperature is below that in the table or when weather conditions otherwise prevent the proper handling, placing and compaction of the mixture.

Cold weather construction is defined as the period between November 1 and April 1. During this period, asphalt mixes shall not be placed unless the surface temperature at the time of placement conforms to Table 401.04 for the type of mixes specified and provided that the ambient air temperature during the past 24 hours was above 32°F. At no time shall the asphalt be placed on frozen subgrade.

**401.05 EQUIPMENT**

Bituminous Mixing Plants – 904.01

Distributors – 904.03

Trucks – 904.02

Lay down Equipment – 904.04

Rollers – 904.05

Hand Tools – 904.06

Milling Machine – 903.01

**TABLE 401.04  
RESTRICTIONS ON PLACEMENT OF BITUMINOUS MIXES**

Mixes	Surface Temperature (°F)	Dates
<b>Surface Mixes</b>		
Lift Thickness		
Less Than 1-1/4”	50	November 1-April 1
Over 1-1/4”	40	November 1-April 1
Base	40	November 1-April 1

**401.06 HAULING OF ASPHALTIC MATERIALS**

Asphaltic paving mixtures shall be transported from the mixing plant to the project site in trucks conforming to the requirements of 904.02.

Shipments found to contain an excess amount of liquid asphalt, moisture, or lubricant, or other foreign material, or if delivered outside of the approved job mix temperature of the bituminous mixture, shall be rejected. No loads shall be dispatched at such time as will prevent completion of the spreading and compaction of the mixture during daylight, unless artificial light satisfactory to the Chief Engineer is provided.

**401.07 PREPARATION OF BASE COURSE OR EXISTING SURFACE**

Before spreading materials, the surface upon which the mix is to be placed shall be cleaned as indicated herein. After cleaning and while surfaces are dry and free from all objectionable matter, Tack Coat, as specified, shall be applied to all areas in accordance with 403.

- (A) **ASPHALTIC BASE COURSE.** Base course shall generally be defined as asphalt base used for roadways with full depth asphalt pavement. Prior to laying base course, all manhole frames within the limits of area to be paved shall be protected from debris entering the structure during paving operations. The manhole shall be cleaned of all concrete, asphalt or other debris. Poles, manholes or other structures projecting through the base course shall be given a heavy coating meeting the requirements of 802.04 or 802.05 prior to placement of asphalt. At limits of all base work, existing pavement shall be sawed full depth, cleaned to a vertical edge, all loose material removed, and tack coat applied. After base course has been laid, the manholes shall be re-set to approved line and grade according to 311.04. Payment will be made according to 311.10 and shall include excavation and PCC base.
- (B) **BASE COURSE JOINTS.** In the event that the roadway being constructed can only be done ½ at a time, the longitudinal joint in the existing new base shall be trimmed back to a clean vertical edge of full depth asphalt using an air compressor or other approved method prior to paving the second half of the roadway. In general, the required cut shall be from 3 to 6 inches from the edge of the cold joint, but in no case shall it be less than 3 inches
- (C) **PCC BASE TO BE OVERLAYED WITH BINDER OR SURFACE COURSE.** Before placing leveling or surface course over existing PCC base, the surface upon which the mix is to be placed shall be cleaned of all loose and spalling material. All joints or cracks

in the existing PCC base, both longitudinal and transverse, and all spalled areas, shall be cleaned of all asphalt and unsound concrete using compressed air to the satisfaction of the Chief Engineer. After the cleaning operation, the Contractor shall completely fill and thoroughly compact asphaltic concrete (Stone Filled Sheet Asphalt Patching) into the joints, cracks, spalled and scaled areas, as directed by the Chief Engineer. After cleaning and while surfaces are dry and free from all objectionable materials, tack coat, as specified, shall be applied to all areas in accordance with 403. Joints and cracks smaller than ½ inch may be sealed with joint sealer meeting the requirements of 807.02 (A) (4), Hot-poured type.

Particular care must be used to avoid discoloration or damage to the curb and gutter. Any Portland Cement Concrete pavement, curb, or gutter broken or damaged through carelessness on the Contractor's part shall be replaced by the Contractor without cost to the District.

When overlaying streetcar tracks, loose rust shall be removed from the tracks by sanding and by use of wire brushes to the satisfaction of the Chief Engineer. Track rail grooves shall be swept clean. Hot mixed asphalt shall not be placed until the Chief Engineer has inspected and approved the condition of the adjacent pavement.

All refuse material shall be hauled away and disposed of by the Contractor at his own expense.

#### **401.08 PREPARATION OF MATERIALS**

- (A) **ASPHALT.** Asphalt Cement as received at the mixing plant shall be such that it will remain within the specified limits throughout the entire period of its use. The asphalt cement when delivered to the mixer shall be at the temperature specified.
- (B) **AGGREGATES.** Aggregates shall be delivered, handled, and stored in a manner so as to prevent segregation, contamination, and mixing of material from other sources. Aggregate storage facilities and handling shall meet the requirements of 106.

Flames used for drying and heating shall be properly adjusted to avoid injury to the aggregates. Absorbed moisture in the aggregate shall be reduced to such a quantity that there is no flushing of asphalt resulting from escaping water vapor in the prepared mixture.

- (C) **HYDRATED LIME.** Hydrated lime shall be delivered, handled and stored in a manner so as to prevent contamination and kept dry until mixed into a slurry.

#### **401.09 MIXING AND HOLDING**

Mineral aggregates, prepared as prescribed in 401.08, shall be combined in the proportionate amounts required to meet the approved job mix formula. The asphalt cement shall be weighed, measured, or gauged and introduced into the mixer in the amount required by the approved job mix formula for the bituminous mixture being produced.

Hydrated lime shall be weighed, measured, or metered and combined with the aggregates prior to drying or mixing in the maximum amount of 1.5 percent hydrated lime by weight of total mixture for the bituminous mixture being produced. The hydrated lime shall be

distributed on the aggregates in the form of lime-water slurry. The lime-water slurry shall have the consistency to allow uniform distribution on the aggregate. Should the Contractor elect to use an alternate method he shall submit his plan to the Chief Engineer in writing for approval along with the job mix formula.

Liquid anti strip additive shall be metered and combined with the asphalt cement prior to discharge into the mixing chamber. When batch plants are used, prior to adding the asphalt cement, the combined mineral aggregates shall be thoroughly mixed dry for 10 seconds. Upon approval of the Chief Engineer, dry mix times may be less than 10 seconds after it has been demonstrated to the Chief Engineer that the requirements of 401.02 are met.

The asphalt cement shall be distributed over the mineral aggregates and the whole mass thoroughly wet mixed for a period of at least 30 seconds to produce a homogenous and uniformly coated mixture. Upon approval of the Chief Engineer, another wet mixing time may be established based on a minimum of 95 percent coated particles as determined by AASHTO T 195. Mixtures with maximum size aggregate passing the No. 4 sieve will be visually examined by the Chief Engineer to determine minimum wet mix times.

The dry mix time is defined as the interval of time between the opening of the weigh box gate and the application of asphalt cement. The wet mix time is the interval of time between the application of asphalt cement and the opening of the mixer gate.

For the continuous mix type plants, the mixing time may be regulated by fixing a minimum gauge in the mixing unit and/or by other mixing unit adjustments that may be directed by the Chief Engineer. All mixing plants for the preparation of bituminous mixtures shall conform to the requirements of 904.01. The mineral constituents of the asphaltic mixture shall be so combined with the asphalt cement so that the resulting composite mixture will meet the grading, bitumen content, and temperature requirements of the approved job mix formula.

Storing or holding of bituminous materials will be permitted provided the characteristics of the mixture are substantially the same as those of the mixing plant.

When allowed, the Contractor shall sample in the presence of the Chief Engineer, hot asphaltic paving mixtures stored for more than 24 hours. Two samples shall be obtained, one from the top and one from the bottom of the storage or surge bin. Test results obtained by the District for both samples shall conform to tolerances of the approved job mix formula. In the event the bitumen content, gradation or temperature of either sample is not within job mix tolerances, the material shall be removed from the roadway at no cost to the District. The Contractor shall provide a sample of the mixture taken between the pug mill and storage or surge bin when requested.

#### **401.10 SPREADING AND FINISHING**

(A) **GENERAL.** Asphaltic paving mixtures shall be laid only on surfaces that are dry and when weather conditions are satisfactory. Spreading of asphaltic mixtures will not be permitted during rain, the placing of mixture overtaken in transit from the plant by a sudden rain, provided the mixture is within the temperature limits specified and can be satisfactorily placed and rolled. Loads mixed and dispatched to the site of work after rain has commenced shall be rejected.

All asphaltic mixtures shall be spread and finished by a bituminous paver where practicable. Permission to spread and finish by hand must be secured from the Chief Engineer. The placing of all asphaltic mixtures shall be as continuous as practicable and in a manner to eliminate joints. Asphaltic mixtures of the same type but from different plants shall not be used alternately on the same section of a project. Contact surfaces of curbs, gutters, manholes and similar structures shall be painted with a thin uniform coating of hot asphalt cement or rapid setting emulsified asphalt, prior to placing the hot asphaltic mixture against them. Bituminous mixtures shall not be placed on a surface that is contaminated.

- (B) PLACING AND FINISHING BY MACHINE.** All spreading and finishing machines shall meet the requirements of 904.04. The width placed by the machine shall be as approved by the Chief Engineer, within the capabilities of the equipment. The Contractor is advised that the echelon method of spreading asphaltic mixtures shall be employed wherever, in the opinion of the Chief Engineer, a roadway is of sufficient width and area to permit the use of two or more pavers or the location of the project requires their use. Direction of the pavers shall not be changed by turning on newly placed bituminous pavements.

When placing asphaltic mixtures, joints shall be formed at the end of each day's work or when placing is discontinued for such period of time that the material cools below 140°F. The joints shall be formed by laying and rolling against boards of the thickness of the compacted mixture or by such methods as may be approved by the Chief Engineer.

- (C) PLACING AND FINISHING BY HAND.** Tools for placing and finishing by hand shall conform to the requirements of 904.06. The Contractor shall provide means for keeping all small tools clean and free from accumulations of asphaltic materials. The mixture shall be distributed by means of hot shovels of approved size and shape and spread with hot rakes to the thickness specified. In spreading, the loose material shall be thoroughly raked throughout its depth. Attention shall be paid to raking the loose material to its full thickness with the tines of the rake in order to eliminate voids. Boards of sufficient length and proper thickness shall be laid on the base course to check the thickness of the loose material and as a means of obtaining a uniform grade. The thickness of the boards shall be frequently checked for accuracy.

Immediately after placing and raking the mixture, and prior to initial rolling, the surface of the mixture shall be smoothed by the use of a lute which conforms to the requirements of 904.06(A).

#### **401.11 COMPACTION OF ASPHALTIC MIXTURES**

A minimum of 2 rollers meeting requirements of 904.05 will be required, a 2-axle 10 to 12 ton tandem roller and a 2-axle roller of 5 ton to 8 ton capacity. No separate or additional compensation will be allowed. At the option of the Contractor and with the approval of the Chief Engineer, intermediate rolling of asphaltic mixtures may be accomplished by the use of self-propelled pneumatic tired rollers meeting the requirements of 904.05. Initial and finish rolling, however, shall be done by steel-wheeled rollers. Each roller shall be operated by a competent, experienced operator, and while work is underway, must be kept as nearly as practicable in continuous operation.

The motion of the roller shall at all times be slow enough to avoid displacement of the mixture and in no case shall the roller speed exceed 130 feet per minute. Any displacement of the mixture occurring as a result of reversing the direction of the roller or from any other cause, and any other surface irregularities developed by rolling, shall at once be corrected by the use of rakes, and fresh mixture applied when required. Straight edging and back patching shall be done immediately after initial compaction has been secured and while the material is still workable. To prevent adhesion of the mixture to the roller, the rolls shall be kept properly moistened, but excessive water will not be permitted.

For a radial distance of 8 inches around all structures including manholes, along curbs, gutters and where it is impracticable to obtain proper compaction with rollers, compaction shall be effected with tampers, smoothing irons or mechanical tampers.

- (A) **BASE AND LEVELING COURSES.** Base and leveling courses shall be rolled starting longitudinally at the extreme sides and proceed toward the center of the pavement, overlapping on each successive trip by about 1/2 the width of the rear roll, but not less than six inches.

No traffic, except in connection with the delivery of asphaltic mixtures, shall be permitted on the newly laid pavement without the permission of the Chief Engineer. All areas which become coated with any foreign material or that are loose shall be removed and replaced with new material.

After compaction, the base or leveling course shall not show an excess of asphalt cement and any material showing such excess shall be removed and replaced with new material. Any material broken up excessively during the process of spreading or rolling or which remains unbound after rolling shall be removed and replaced with new material. Rolling of base courses shall continue until all roller marks are eliminated.

- (B) **SURFACE COURSES.** Rolling of surface courses shall start longitudinally at the extreme sides and proceed toward the center of the pavement, overlapping on each successive trip at least 1/2 the width of rear roll. If required by the Chief Engineer, the surface shall then be subjected to a diagonal rolling in 2 directions, the second diagonal crossing the lines of the first. Rolling of surface courses shall continue until all roller marks are eliminated and required compaction attained.

The surface course after compaction shall not show any excess of asphalt cement and any material showing such an excess shall be removed and replaced with new material. Any material broken up excessively during the process of spreading or rolling or which remains unbound after rolling shall be removed and replaced with new material.

- (C) **DENSITY REQUIREMENTS.** The Bituminous Concrete pavements shall be compacted to the densities indicated herein:

Base and Leveling Courses – not less than 94 percent of the bulk density of a standard specimen as prescribed in AASHTO T 166 for the job mix formula.

Surface Courses – not less than 96 percent of the bulk density of a standard specimen as prescribed in AASHTO T 166 for the job mix formula.

When a reference mold density per AASHTO T 166 is not available, the specific gravity determined by AASHTO T 209 will be used with the following minimum requirements; surface course, 92 percent, leveling course, 88 percent and base course, 90 percent.

#### **401.12 SURFACE COURSE JOINTS**

In the event that surface course paving by the echelon method is not required or permitted, or the joint cools below 140°F, or where the new asphalt is placed against an old pavement, surface course longitudinal joints shall be cut back on a vertical face by means of a power masonry saw, or alternative method approved by the Chief Engineer, until a thoroughly compacted full thickness of section is exposed. In general, the required cut shall be from 3 to 6 inches from the edge of the cold joint, but in no case shall it be less than 3 inches. Disposal of materials removed from cut joint shall be included in work. Traffic shall not be permitted to cross the cut edge prior to placing adjoining lane. Before placing fresh asphalt mix against cut joint, adjacent area of old pavement shall be thoroughly cleaned and the exposed cut edge shall be given a light coat of rapid set emulsified asphalt. The fresh mixture shall then be raked against the joint and thoroughly tamped with hot tampers and rolled.

The surface across all joints shall be tested with a 10 foot straightedge meeting the requirements of 903.03 and shall meet the requirements for smoothness of asphaltic surface of these specifications.

#### **401.13 PAVEMENT SAMPLES**

When specified, the Contractor shall cut samples from the compacted pavement for testing by the Chief Engineer. Samples of the mixture shall be taken for the full depth of the course at the locations directed by the Chief Engineer.

#### **401.14 SURFACE TOLERANCES**

The Contractor shall have available at all times a 10 ft straightedge approved by the Chief Engineer. Appendix I and II - DDOT's Special Provision for Pavement Ride Quality and all other applicable sections in this Standard shall be applied on all the National Highway System (NHS) roads.

Immediately following second or intermediate rolling, the surface will be tested in the approximate center of each wheel lane with a 10 ft straightedge approved by the Chief Engineer.

The surface of each asphalt pavement course shall be true to the established line and grade and shall be sufficiently smooth so that when tested with a 10 ft straightedge placed upon the surface parallel to the centerline, the surface shall not deviate by more than 1/8 inch. The surface of the transverse slope of the finished surface of each course when tested with a 10 ft straightedge placed perpendicular to the centerline, shall not deviate more than 3/16 inch. Any irregularities exceeding these tolerances must be corrected.

The entire affected area of any surface irregularity found shall be loosened promptly and sufficient material removed or new material placed to form a true and even surface. Its location will be marked and rechecked by the Chief Engineer after final compaction is complete.

Any such irregularity, as determined by the Chief Engineer, shall be removed to its full depth and new material laid to form a true and even surface, and the costs thereof shall be borne by the Contractor.

The surface within areas occurring on arcs of vertical and horizontal curves, within 25 feet of the P.C. or P.T., within 25 feet of an intersecting street or within 25 feet of a change in grade, will not be considered in road rater tests. However, irregularities at these locations may be ascertained by accurate survey measurements with due consideration given to specified changes in grade.

#### **401.15 PROTECTION OF ASPHALTIC PAVEMENT**

After the asphaltic mixture has received its final rolling, no vehicular traffic shall be permitted on the pavement until it has properly hardened as determined by the Chief Engineer.

#### **401.16 CLEANING UP**

On completion of the work, all surplus materials, dirt, and debris of every description shall be removed and the area cleaned to the satisfaction of the Chief Engineer. The edges of the surface course adjacent to gutters, curbs or shoulders shall be neatly trimmed.

#### **401.17 PAVEMENT CORES**

- (A) **GENERAL.** The Contractor shall provide the equipment and labor needed to obtain pavement cores for consolidation (compaction) and pavement thickness verification. A minimum of three (3) cores per block per lane or 500 feet per lane of pavement shall be obtained by water cooled diamond bits for minimum disturbance of the finished pavement. The created holes shall be filled and compacted with asphalt mix in layers not exceeding 2 inches in thickness. The total number and size of cores shall represent the minimum surface area or quantity as specified in AASHTO T 168, Sampling Bituminous Paving Mixtures. The location of the cores shall be as selected by the Chief Engineer. The Contractor shall obtain pavement cores at the direction of the Chief Engineer within 24 hours of placement of asphalt. Cores shall be given to the Chief Engineer at the project site.
- (B) **MEASURE AND PAYMENT.** No measure or payment will be made. Cost of Pavement Cores shall be reflected and distributed among Asphalt Pay Items.

#### **401.18 ADJUSTMENT OF PRICE FOR ASPHALT BINDER**

An adjustment will be made to the contract unit price of Hot Mix Asphalt items if the price of asphalt fluctuates significantly from the prevailing prices set by DDOT as base price or as quoted in the contract documents to the date of placement. The contract unit price will be adjusted by the amount of fluctuation above 5% for contracts scheduled to be paved during more than one construction season or having an estimated mix quantity of 10,000 tons or more. For contracts completed within one construction season and having a mix quantity of less than 10,000 tons, the adjustment will be based upon the amount of fluctuation more than  $\pm 15$  per cent. Only the differential per cent change beyond the above noted 5 to 15 per cent will be used.

For purposes of making these calculations, a monthly price index will be maintained by DDOT. This index will be the average F.O.B. selling price of asphalt binder at the supplier's terminal in the District of Columbia or closest to the District of Columbia.

The adjusted contract unit price of hot mix asphalt will be computed monthly by using the following formula:

$$F = (PP-PB)/PB \times 100$$

Where: F = percent price increase/decrease of asphalt binder  
 PP = index price of asphalt binder per ton at placement date, and  
 PB = prevailing index price of asphalt binder per ton as specified in the Invitation for Bids or as fixed by DDOT

Adjusted contract unit price due the Contractor when price of asphalt binder increase:

$$A = B + (D \times T \times PB)$$

Adjusted contract unit price due DDOT when price of asphalt binder decreases:

$$A = B - (D \times T \times PB)$$

Where: A = adjusted contract unit price per ton of Hot Mix Asphalt  
 B = Contract unit price per ton of Hot Mix Asphalt  
 D = differential percentage expressed as a decimal (F-5 per cent or F-15 per cent as defined above)  
 T = design target asphalt content expressed as a decimal  
 PB = prevailing index price of asphalt binder per ton as specified in the contract or as fixed by DDOT

## 402 SUPERPAVE HOT BITUMINOUS PAVEMENT

### 402.01 DESCRIPTION

This work shall consist of constructing one or more courses of bituminous pavement in accordance with the requirements of 401, these specifications, and shall be in conformity with the lines, grades, thicknesses and cross sections shown in the contract documents and as directed by the Chief Engineer. The asphaltic mixture shall be either Superpave 25.0mm, Superpave 12.5 mm, or Superpave 9.5 mm as designated and composed of a mixture of asphalt cement, coarse aggregates, fine aggregates, and anti strip additive, or hydrated lime, as required by the approved job mix formula.

### 402.02 MATERIALS

Requirements of 401.03 apply except as modified herein.

- (A) **COARSE AGGREGATE** shall conform to 803.04.
- (B) **FINE AGGREGATE** shall conform to 803.03.
- (C) **STONE SCREENINGS**. No. 10 aggregate as specified in 803.03(A) and shall be non-plastic.
- (D) **HYDRATED LIME**. 822.03(A)
- (E) **ANTI STRIP ADDITIVE** – 802.08

### 402.03 CONSTRUCTION REQUIREMENTS

The Construction requirements shall be as prescribed in 401 and compacted as follows:

1. Hot Asphaltic Concrete (Superpave 25.0 mm, 19.0 mm base course or Superpave 9.50 mm leveling Course) shall be compacted to not less than 94 percent of the bulk density of a standard specimen compacted as prescribed in AASHTO T 166 or not less than 90 percent of the maximum specific gravity determined in accordance with AASHTO T 209.
2. Hot Asphaltic Concrete (Superpave 12.5 mm and 9.5 Surface Course) shall be compacted to not less than 96 percent of the bulk density of a standard specimen compacted as prescribed in AASHTO T 166 or not less than 92 percent of the maximum specific gravity determined in accordance with AASHTO T 209.
3. Hot Asphaltic Concrete pavement for base shall be placed in layers not to exceed 4 inches compacted thickness unless otherwise approved by the Chief Engineer.
4. Hot Asphaltic Concrete pavement for surface shall be placed in layers not to exceed 2 inches compacted thickness unless otherwise approved by the Chief Engineer.

### 402.04 MEASURE AND PAYMENT

The unit of measure for Hot Asphaltic Concrete of the class specified will be the ton. The number of tons will be the actual number of tons complete in place as weighed on approved truck scales. The Chief Engineer will deduct the weight of all material lost, wasted, damaged,

rejected or applied in excess of the Chief Engineer's direction or contrary to these specifications.

The number of tons of the class specified will be paid for at the contract unit price per ton, which payment will be full compensation for the work specified complete in place.

## **403 TACK COAT**

### **403.01 DESCRIPTION**

Work shall consist of applying, where directed by the Chief Engineer, a Tack Coat conforming to 802.05. The Tack Coat shall be pressure sprayed in the form of a spray mist onto clean roadway surfaces at a uniform rate of 0.01 to 0.05 gallon residual asphalt per square yard. Emulsions shall be diluted in the ratio of 3 parts emulsion to 1 part water by volume prior to use. Spraying equipment shall be approved in advance by the Chief Engineer.

### **403.02 CERTIFICATION**

Each delivery of tack coat from the refinery shall be accompanied by a copy of certified test results from testing completed not more than four weeks prior to delivery of the material. Certification shall include a statement as to type, and amount of material contained in each carrier and the identification of the storage tanks from which the material is delivered, with quantities determined from a certified gallon ticket for each location of work. The certification shall be presented to the Chief Engineer upon delivery.

### **403.03 CONSTRUCTION REQUIREMENTS**

Roadway surfaces shall be prepared and properly cleaned by power broom, compressed air, or other suitable means and existing thermoplastic and/or pre-molded plastic markings removed prior to tack coat application. Tack coat shall be applied sufficiently in advance so that a tacky surface exists at time asphalt surface mix is placed. After tack coat application, it shall be worked into the roadway surface by use of rubber tired equipment approved by the Chief Engineer. Extra tack coat shall not be applied except with the specific approval of the Chief Engineer. The time interval between application of the tack coat and placement of the asphalt mix shall be sufficient to allow the tack coat to set (break). In no case shall the time interval between application of the tack coat and placement of the asphalt mix be less than 10 minutes. All necessary precautions shall be taken to prevent staining of curb and gutter surfaces. In the event such staining occurs, it shall be removed at the Contractor's expense.

### **403.04 MEASURE AND PAYMENT**

The unit of measure for Tack Coat will be the square yard.

Payment for tack coat will be made at the contract unit price per square yard complete in place, which payment will include proper cleaning of roadway, removal of pavement marking, furnishing and applying the tack coat, working tack coat into surface, extra tack coat where authorized and all labor, materials, tools, equipment and incidentals needed to complete specified work.

## 404 SLURRY SEAL

### 404.01 DESCRIPTION

Slurry Seal consist of mixing and placing a bituminous mixture on clean roadway surfaces in conformance with these specifications, where shown on the plans and/or where directed by the Chief Engineer.

### 404.02 COMPOSITION

Slurry Seal shall consist of emulsified asphalt, mineral aggregate and water; and when required, may also consist of portland cement and/or an additive. Slurry Seal shall contain 2.5 to 3.0 gallons of asphalt emulsion for every 100 pounds of mineral aggregate, and the amount of water shall be regulated for proper consistency.

### 404.03 MATERIALS

- (A) **ASPHALT EMULSION.** Asphalt emulsion shall conform to the requirements of 802.05.
  - (1) Emulsified Asphalt – AASHTO M 140, Grade SS-1 or 1h.
  - (2) Cationic Emulsified Asphalt – AASHTO M 208, Grade CSS-1 or 1h.
- (B) **MINERAL AGGREGATE.** Mineral aggregate shall consist of clean aggregate and mineral filler, combined to meet the gradation of 803.08. For the portion passing the No. 200 sieve, portland cement may be used in an amount up to 2 percent by weight total aggregate mix to increase mixing time.
- (C) **WATER.** Water shall be free from foreign matter.
- (D) **ADDITIVE.** An additive may be mixed with the water to extend the mixing time as temperatures increase.

### 404.04 CONSTRUCTION REQUIREMENTS

- (A) **SURFACE PREPARATION.** Roadway surfaces shall be prepared and properly cleaned by power broom, compressed air or other suitable means prior to Slurry Seal application. Prior to application of slurry seal, pavement surface and all crack faces shall be sprayed with water.
- (B) **WEATHER AND TEMPERATURE.** Slurry seal shall be placed only when ambient air temperature is 60° F or above. Slurry seal shall not be placed if rain is pending before the mix can properly set.
- (C) **CONSTRUCTION METHODS.** A continuous feed-mix-flow spread slurry machine shall be used to produce and place creamy textured slurry that, when spread, will flow in a wave approximately 2 feet ahead of the strike- off squeegee to a minimum thickness of 1/4 inch, as well as flow into and fill pavement cracks, before the strike-off passes over. Where cracks exceed 1 inch in depth and 1/2 inch in width, they shall be first filled with the slurry mix prior to placing Slurry Seal over the entire surface.

The surface shall be damp, but no free water shall remain when slurry mix is applied. Slurry seal shall be applied sufficiently in advance of overlay so that the slurry mat may set. The time interval between application of the slurry seal and placement of the asphalt mix will be regulated by the Chief Engineer.

Traffic shall be kept off the slurry seal until it has set sufficiently to prevent pick-up of the mix. Hand work with squeegees will be required as needed.

A pneumatic tired roller with smooth treads shall be used as directed by the Chief Engineer.

**404.05 MEASURE AND PAYMENT**

The measure for Slurry Seal will be the square yard in place.

Payment will be made at the contract unit price per square yard complete in place, which payment will include proper cleaning of roadway, furnishing and applying the slurry mix, curing, and all labor, tools, materials, equipment and incidentals needed to complete specified work.

## 405 BITUMINOUS SURFACE TREATMENT

### 405.01 DESCRIPTION

The work shall consist of Bituminous Surface Treatment of stabilized soil, macadam, or other designated surfaces or bases including the furnishing of the materials and their application. Work also includes furnishing and placing all materials required for Asphalt Surface Treatment of the roadway shoulders.

### 405.02 MATERIALS

Materials used for Bituminous Surface Treatment shall conform to the requirements of 401.02 except as modified herein:

- (1) Asphalt, for cold surface treatment – AASHTO M 208, Grade CRS-2, or AASHTO M 140, Grade RS-2, or as specified.
- (2) Asphalt, for cold weather construction – AASHTO M 81, Grade RC-250.
- (3) Asphalt, for hot weather construction – AASHTO M 208, Grade CRS-2.
- (4) Aggregate, for bituminous surface treatment – 803.09.
- (5) Aggregate, for shoulder treatment – shall be light colored crushed stone to provide delineation under conditions of poor visibility between the traveled roadway and treated shoulder area. The Contractor shall submit to the Chief Engineer a 10 pound sample of aggregate from at least 3 different sources so that proper color selection may be made.

### 405.03 CONSTRUCTION REQUIREMENTS

- (A) **SURFACE PREPARATION.** The surface of the roadway to be treated shall be swept thoroughly clean of dust or other extraneous materials by a mechanical sweeper immediately in advance of the application of the bituminous material. Leavings of the mechanical sweeper shall be removed by hand brooming. In any closely-built section, hand brooming only shall be done if so directed by the Chief Engineer.

Following the brooming and cleaning, which shall be done to the satisfaction of the Chief Engineer, signs, barricades, flags and other warning devices furnished at the Contractor's expense shall be stationed in such quantities and position as directed by the Chief Engineer. All manhole covers, water box frames and covers and utility openings shall be covered with sand or paper to prevent the application of bituminous material thereon. The sand or paper shall be removed and disposed of as soon as the aggregate has been applied. On streets where there is curb and gutter, the gutter edges directly abutting the surface to be treated shall be built up with a dike of sand or earth to prevent spotting of concrete curb or gutter with the bituminous material.

(B) **APPLICATION OF BITUMINOUS MATERIALS**

- (1) **WEATHER LIMITATION.** The ambient temperature shall be 50°F or above, and the weather not foggy or rainy. Temperature and seasonal requirements may be adjusted only when so directed by the Chief Engineer in writing.

- (2) **BITUMEN TEMPERATURE.** The temperature of cold bituminous materials at the time of application shall be between 125°F and 175°F. The temperature of hot bituminous materials at the time of application shall be between 275°F and 325°F.
- (3) **METHODS.** Bituminous material for surface treatment shall be applied only when the condition of the surface is satisfactory to the Chief Engineer.

Ninety percent of the application shall be accomplished by means of a pressure distributor meeting the requirements of 904.03, but when so directed by the Chief Engineer, a hand hose shall be used.

The amount and rate of application will vary due to surface texture, roughness or cracking of the old surface and shall be set for each individual street by the Engineer. This rate will be from 1/4 to 1/2 gallon per square yard for any single application.

At all starting places, the nozzles shall be going full force when starting the treatment on the pavement and upon the completion of any application of bitumen from the distributor, care shall be exercised to prevent nozzles from dripping on the adjacent pavement.

In cases where an entire load of bitumen will not be applied in a continuous run, short runs will be made as directed by the Engineer.

Ruts, thin spots, or bare streaks occurring from faulty operations or other causes shall be remedied before the cover material is spread.

Bituminous material shall not be applied to any stretch of roadway when aggregate and rolling equipment is not immediately available. Bituminous application shall be suspended sufficiently early in the day to permit covering and rolling of all treatment portions before the close of the work period of that day.

- (C) **SPREADING AND COMPACTING AGGREGATES.** Aggregates shall be free of surface moisture when spread. They shall be spread in a uniform layer by means of a mechanical spreader, unless otherwise permitted by the Engineer, at the rates directed for the respective roadways and immediately following the application of the bituminous material and before the same shall have become set.

A hand spreading crew shall immediately follow the mechanical spreader to remove excess material and touch up bare spots prior to rolling.

The rates of application of aggregates will vary as directed by the Chief Engineer from 15 to 30 pounds per square yard.

No traffic, except at intersections, shall be permitted upon the freshly covered roadway prior to a thorough rolling. The rolling shall be accomplished with 3 wheel rollers, weighing not less than 8 or more than 10 tons and conforming to the requirements of 904.05. The Contractor shall be required to have 2 rollers upon the job at all times and rolling shall be continued to the satisfaction of the Engineer.

- (D) **ASPHALT SHOULDER TREATMENT.** The asphalt surface treatment for shoulders shall consist of a single application each of asphalt binder and aggregate, and then rolling, all in accordance with requirements of 401.11.

The application rate for shoulder treatment shall be approximately as follows:

Aggregate <u>Grading</u>	Distribution Rate <u>Lbs. per Sq. Yd.</u>	Gallons of Binder <u>per Sq. Yd.</u>
No. 8	20	0.2 – 0.3

If asphalt material is shipped to the job in a tank truck, the Contractor shall furnish the Chief Engineer a certified chart showing dimensions and volume at 60°F per inch depth for each tank until the final measurement has been taken by the Engineer.

All asphalt shoulder treatment aggregate that is shipped to the job shall have a ticket marked with the weight, truck number, and railroad car number, if applicable.

#### 405.04 CLEANING UP

In addition to the requirements of 401.16, cleaning up shall include the following:

Aggregate swept off the surface by traffic shall be thrown or swept back after completion of rolling until all excess bituminous material has been absorbed. Any aggregate remaining free on the roadway or adjacent thereto after completion shall be removed at the Contractor's expense as directed by the Engineer. The aggregate so removed shall be dumped in a designated stockpile.

#### 405.05 MEASUREMENT

(A) **BITUMINOUS MATERIAL FOR BITUMINOUS SURFACE TREATMENT.** The unit of measure for Bituminous Material for Bituminous Surface Treatment will be the gallon. In determining the quantities of bituminous material for payment, the original volume (gallons) shown on the shipper's car invoice corrected to 60°F shall govern when the material is shipped in a railroad tank car. When the material is shipped in a tank truck, the Contractor shall furnish the Chief Engineer a certified chart showing the dimensions and volume at 60°F per inch depth for each tank until the final measurement has been taken by the Engineer. The measurements shall be taken when the bituminous material is of a uniform temperature and free from air bubbles. The quantity shall be corrected to 60°F, as specified in the current "ASTM-IP Petroleum Measurement Tables", ASTM Designation D 1250, or ASTM Designation D 633, "Volume Correction Table for Tar and Coal Tar Pitch".

The quantity of bituminous material in gallons may be determined by securing the net weight of the material used and converting the weight into gallons at 60°F. If this method is used, an individual ticket showing the weight and volume (gallons) shall be furnished for each load of bituminous material.

(B) **AGGREGATES FOR BITUMINOUS SURFACE TREATMENT.** The unit of measure for Aggregate for Bituminous Surface Treatment will be the ton. Railroad weights for tonnage of aggregate may be accepted or the Contractor may be required to reweigh this material on a platform scale as each load leaves the unloading point. Each individual truck load of material shall have a ticket marked with the weight, truck number and railroad car number.

(C) **ASPHALT SHOULDER TREATMENT.** The unit of measure for Asphalt Shoulder Treatment will be the square yard, complete in place.

**405.06 PAYMENT**

- (A) **BITUMINOUS MATERIAL FOR BITUMINOUS SURFACE TREATMENT.** The number of gallons of Bituminous material, as measured in 405.05(A), will be paid for at the contract unit price per gallon, which payment will include all preparatory work such as sweeping and cleaning the surface, maintenance of barricades, furnishing, hauling, and placing the material, and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.
- (B) **AGGREGATES FOR BITUMINOUS SURFACE TREATMENT.** The number of tons of Aggregates, as measured in 405.05(B), will be paid for at the contract unit price per ton, which payment will include all preparatory work, maintenance of barricades, furnishing, hauling, and placing the material and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.
- (C) **ASPHALT SHOULDER TREATMENT.** Payment for Asphalt Shoulder Treatment will be made at the contract unit price per square yard, which payment will include furnishing, hauling, and placing all materials and for furnishing all labor, materials, tools, equipment and incidentals needed to complete specified work.

**406 RECYCLED BITUMINOUS PAVEMENT AS BASE OR LEVELING COURSE****406.01 DESCRIPTION**

This work shall consist of preparing and placing plant mixed recycled bituminous concrete on a prepared surface in accordance with this specification and the applicable requirements of 401.

The Contractor shall have the option of substituting plant mixed asphaltic concrete for the plant mixed recycled bituminous concrete.

The Contractor shall have the option of using asphalt concrete millings that are removed from this contract, if any, or asphaltic concrete from an existing stockpile, or any combination of the foregoing.

**406.02 COMPOSITION**

Recycled Bituminous Pavement as Base Course shall consist of recycled asphaltic concrete, coarse aggregate, fine aggregate, mineral filler, asphalt cement, modifying agent and hydrated lime or anti strip additive as required by the approved job mix formula.

**406.03 MATERIALS**

Asphalt Cement shall conform to the requirements of 818 and AASHTO M 320. The delivery and certification requirements of 802.01 apply.

Coarse Aggregate shall conform to the quality requirements of the type of bituminous base or leveling course specified.

Fine Aggregate shall conform to the quality requirements of the type of bituminous base course specified.

Mineral Filler – 803.05

Modifying Agent, if not asphalt cement – 802.07

Hydrated Lime – 822.03(A)

Anti Strip Additive – 802.08

Recycled Asphaltic Concrete shall consist of asphalt concrete millings or crushed bituminous pavement with maximum nominal size determined by maximum nominal size of base course specified, and in no case exceed 1 inch. There shall be little evidence of deleterious materials in the recycled asphaltic concrete.

**406.04 JOB MIX FORMULA**

The job mix formula requirements of 401.02 apply for the class of base course specified, except the portion of recycled asphaltic concrete of the total Recycled Bituminous Pavement mixture shall not exceed 20 percent by weight.

A blend of asphalt cement, modifying agent, anti strip additive and recovered bitumen shall be proportioned to meet the requirements of 802.02 (A) and 802.02 (B). Bitumen shall be recovered from the recycled asphaltic concrete using the Abson method.

The Contractor should allow 20 working days to receive approval or rejection of a proposed job mix formula after it has been submitted to the Chief Engineer for approval.

Section 818.01 6.f., "Other", may include recycled asphaltic concrete, modifying agent and anti stripping additive or hydrated lime.

#### **406.05 CONSTRUCTION REQUIREMENTS**

**(A) GENERAL.** The construction requirements for the type of mix specified apply.

**(B) METHOD.**

- (1) Recycled Asphaltic Concrete will be sized prior to entering the cold feed to the maximum 1 inch nominal size. If there is evidence of the millings not breaking down during the heating and mixing, the Chief Chief Engineer may elect to modify the 1 inch maximum nominal size requirement.
- (2) Gradation for the fine aggregate and/or coarse aggregate used in the production of the recycled bituminous pavement shall be the total responsibility of the Contractor and when combined with recycled asphaltic concrete, the combined material will meet the approved job mix formula gradation within the construction tolerances of 401.02.

#### **406.06 MEASURE AND PAYMENT**

The unit of measure for Recycled Bituminous Pavement as Base or Leveling Course of the class specified will be the ton. The number of tons will be the actual number of tons complete in place as weighed on approved truck scales. The Chief Engineer will deduct the weight of all material lost, wasted, damaged, rejected or applied in excess of the Engineer's direction or contrary to these specifications.

The number of tons of Recycled Bituminous Pavement as Base or Leveling Course of the class specified, as measured, will be paid at the contract unit price per ton, which payment will be full compensation for furnishing, hauling, and placing all materials and for furnishing all equipment, tools, labor and incidentals necessary to complete the work as specified herein.

## **407 TEMPORARY ASPHALT CONCRETE**

### **407.01 DESCRIPTION**

Work shall consist of furnishing, hauling and placing hot asphaltic concrete in areas designated by the Chief Engineer for temporary connections to existing roadways, sidewalks and detours as shown on the plans or as directed by the Engineer, as may be necessary to maintain pedestrian and vehicular traffic and to protect protruding street structures, expansion dams, etc. Work shall include the removal and disposal of Temporary Asphalt Concrete when no longer required.

### **407.02 MATERIALS**

Temporary Asphalt Concrete shall meet the requirements of 402 for Hot Asphaltic Concrete, Superpave mixes, 12.5 mm or 9.5 mm..

### **407.03 ALTERNATE**

In case of emergency, when the specified material is not readily obtainable, a suitable hot asphaltic concrete material may be substituted as an equivalent alternate, subject to prior approval of the Engineer.

In case of extreme emergency, when the specified material is not readily obtainable, and a suitable hot asphaltic concrete material is not available, a cold asphalt mix may be substituted as an equivalent alternate, subject to prior approval of the Engineer.

### **407.04 MEASURE AND PAYMENT**

Measure and Payment for Temporary Asphalt Concrete shall be made in conformance with 402.04. Payment will include removal and disposal of materials no longer needed.

## 408 STONE FILLED SHEET ASPHALT PATCHING

### 408.01 DESCRIPTION

This work shall consist of constructing a thin surface repair or skin patch in areas of spalled pavement, deteriorated joints and streetcar track rail grooves or as directed by the Engineer.

### 408.02 MATERIALS

Tack Coat – 802.04

Stone Filled Sheet Asphalt Surface – 818

### 408.03 CONSTRUCTION REQUIREMENTS

All defective material, asphalt and tar patch, spalled and cracked pavement, faulty joints and joint material, unsound concrete and asphalt shall be removed. The area shall be carefully cleaned to the satisfaction of the Engineer. Loose rust shall be removed from car tracks by sanding and by use of wire brushes to the satisfaction of the Engineer. Car track rail grooves shall be swept clean.

The perimeter of the repair shall be cut to a neat line as defined in 410.03(C) when the repair is to become part of the permanent roadway surface. A neat line cut is not required where the repair is to be covered or resurfaced.

Dust and dirt shall be removed by compressed air or by careful brooming so as to leave surface dry and clean to sound concrete.

As soon as practicable after cleaning and while surfaces are free of all objectionable matter and dry, a tack coat shall be applied as specified in 403.

Sheet asphalt shall be carefully placed by hand in patch areas and in track rail grooves. The asphalt mix shall be compacted by hand methods and followed by mechanical compaction. Work shall be complete and open to traffic for at least 3 days prior to placing asphalt cover courses. Minor depressions which develop under traffic may be filled as part of the first surface course.

### 408.04 MEASURE AND PAYMENT

The unit of measure for Sheet Asphalt Patching will be the ton of sheet asphalt used for this purpose complete in place.

Payment will be made at the contract unit price per ton, which payment will include all removal and cleaning operations, disposal of excavated materials, repair of pavement damaged by Contractor, cutting to a neat line when required, tack coat, furnishing, placing and all compaction of the asphalt, curing and all labor, materials, tools, equipment and incidentals necessary to complete specified work.

## **409 ASPHALT PATCHING**

### **409.01 DESCRIPTION**

This work shall consist of the removal of defective areas of asphalt and shallow depths of concrete pavements including joints and joint material and the replacement with bituminous materials in areas directed by the Engineer.

### **409.02 MATERIALS**

Tack Coat – 802.04

Superpave Surface, 12.5mm or 9.5 mm – 402.02

Superpave Binder Course, 9.5 mm – 402.02

Superpave Base Course, 19mm or 25 mm – 402.02

### **409.03 CONSTRUCTION REQUIREMENTS**

All defective areas shall be cut out and thoroughly cleaned of loose materials to a depth where the pavement appears to be sound. The Contractor may use the most economical method for the removal of this material with the approval of the Chief Engineer.

The perimeter of the repair shall be cut to a neat line as specified in 410.03(C) when the repair is to be part of the roadway surface. A neat line is not required where the repair is to be covered or surfaced.

After the patch is complete traffic is to be placed on the patch for at least 3 days prior to surfacing.

Minor depressions which develop may be filled and compacted as part of the first surface course.

### **409.04 MEASURE AND PAYMENT**

Unit of measure for Asphalt Patching will be the ton of asphalt mixture used for this purpose complete in place.

Payment will be made at the contract unit price per ton, which payment will include all removal and cleaning operations, disposal of excavated materials, tack coat, furnishing, placing and all compaction of the asphalt, curing and all labor, materials, tools, equipment and incidentals needed to complete the specified work.

## 410 REPAIR – REPLACE BITUMINOUS SURFACES AND BASE

### 410.01 DESCRIPTION

This work shall consist of the covering of cuts in bituminous surfaces for underground installations, removing and replacing the binder and surface courses in defective areas, and miscellaneous minor construction; such repairs and construction to be executed as directed by the Chief Engineer and to include all incidental work necessary to complete the repair as ordered.

### 410.02 MATERIALS

The materials for the repair work shall meet the requirements as specified for the type of pavement to be repaired. For each asphalt mix, the Job Mix Formula shall conform to the requirements of 818.

### 410.03 CONSTRUCTION REQUIREMENTS

The Contractor shall not make excavations or pavement openings to a greater extent than can be replaced and repaved during the same working day unless otherwise approved by the Engineer. Bituminous Surface and Base courses shall be replaced by new construction which closely conforms to the specifications for the type of material which was removed with the following additions.

- (A) **CUTTING OUT DEFECTIVE AREAS.** All defective base and surface course material shall be cut out and the loose material removed and disposed of outside the area of work at the Contractor's expense. This shall be accomplished as soon as possible and in no case shall the material be left on the project overnight.
- (B) **REPAIR OF CUTS.** When the pavement base in the cut areas has been replaced, the existing asphalt must be sawn to a neat line and the base thoroughly cleaned and a tack coat applied before new surface material is placed upon it.
- (C) **CUTTING TO A NEAT LINE.** The perimeter of all cuts and/or defective area repairs in asphalt roadways, alleys, sidewalks, gutters and other miscellaneous pavements which become part of the permanent roadway surface shall be cut to a neat line by means of power saw. All surface will be sawn to a minimum depth of 1 inch.

The new material shall be placed on the same day as the asphalt is removed adjacent to the neat line. Should the Contractor fail to place the asphalt surface the same day, a new saw cut may be required.

A hand torch will be available to remove patching material from the existing roadway.

No separate payment shall be made for the use of the power saw.

- (D) **COMPACTION OF BITUMINOUS MATERIAL.** The bituminous mixture shall be compacted in accordance with the method specified for the type of pavement being repaired except that a 5-ton roller may be used where the area is less than 50 square yards. An approved vibrating roller may be used in areas where other rollers are not practicable.

Base and surface mixture adjacent to old pavement or structures shall be tamped as in the case of the surface mix.

When directed by the Engineer, on any repairs, the asphalt base course shall be omitted and replaced by the Portland Cement Concrete base. This is intended for small repairs where it is impracticable to compact the binder course with a roller. The elevation of the finished concrete bases shall be sufficiently below the pavement surface to allow for the placing and proper compaction of the specified thickness of surface mixture.

The surface of the repaired area shall be left smooth and even with the adjoining surface. No vehicular traffic of any kind shall be permitted on the bituminous surface until it has hardened sufficiently.

#### **410.04 WASTED MATERIAL**

Deduction will be made for the actual quantity of materials wasted or not used after delivery.

#### **410.05 MEASURE AND PAYMENT**

- (A) **ASPHALT SURFACE.** The unit of measure of Asphalt Surface of the type specified for covering cuts or street openings and for repairing asphalt pavements will be the ton. The actual number of tons measured complete in place will be paid for at the contract unit price per ton, which payment will include sawing, tacking, removing and disposing of existing materials and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.
- (B) **ASPHALTIC CONCRETE BASE.** The unit of measure for Asphaltic Concrete Binder, as used in sheet asphalt pavements, for covering cuts or street openings and for repairing sheet asphalt and asphalt block pavements, will be the ton. The actual number of tons measured complete in place will be paid for at the contract unit price per ton, which payment will include removal and disposal of existing materials and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

**411 ASPHALT BIKE PATH****411.01 DESCRIPTION**

This work shall consist of constructing a hot asphaltic concrete bike path on a prepared grade to the line, grade and dimensions specified in the contract documents.

**411.02 MATERIALS**

Hot Asphaltic Concrete Surface – 818 for the Type specified.

**411.03 CONSTRUCTION REQUIREMENTS**

The pertinent provisions of 401 apply except that a 3 to 5 ton roller shall be used to obtain the required compaction. A 3 wheel roller will not be required. Hand work in certain areas may be approved when machine-laid asphalt would be impracticable.

**411.04 MEASURE AND PAYMENT**

The unit of measure for Asphalt Bike Path will be the ton. The actual number of tons of hot asphaltic concrete used will be paid for at the contract unit price per ton, which payment will include furnishing all labor, equipment, materials and other incidentals necessary to complete the work as specified.

**412 STONE FILLED SHEET ASPHALT SURFACE COURSE****412.01 DESCRIPTION**

Stone Filled Sheet Asphalt Surface Course shall consist of constructing hot mixed, hot laid bituminous concrete to a minimum of 1/2 inch as an overlay on clean pavement which first has been given a tack coat as specified in 406. The requirements of 401 apply, except as modified herein.

**412.02 COMPOSITION**

Stone Filled Sheet Asphalt Surface Course shall consist of asphalt cement, fine aggregate, mineral filler and anti-strip or hydrated lime as required by the approved job mix formula.

**412.03 MATERIALS**

Requirements of 401.02 apply except as modified herein. Asphalt cement shall meet the requirements of 802.02(A). Each delivery of asphalt cement from the refinery shall be accompanied by a copy of recently (not more than four weeks) certified test results on the material being delivered and a statement as to the type and amount of material contained in each carrier and the identification of the storage tank from which the material is being delivered. This statement shall be presented to the Chief Engineer or his representative upon delivery.

Fine aggregate shall meet the requirements of 803.03(B).

**412.04 CONSTRUCTION REQUIREMENTS**

Compaction of Stone Filled Sheet Asphalt Surface Course shall not be less than 96 percent of the bulk density of a standard specimen computed as prescribed in AASHTO T166 for the number of molding blows as required for the job mix formula or not less than 88 percent of the maximum specific gravity determined in accordance with AASHTO T 209.

The use of electronic sensors and the 3 axle tandem roller will not be required for laying and compacting this material.

**412.05 MEASURE AND PAYMENT**

The unit of measure for Stone Filled Sheet Asphalt Surface Course will be the ton, with quantities determined from certified weight tickets. The square yardage of completed resurfacing on each designated street will be measured and compared against weight tickets. It is the prime objective to obtain an average resurfacing thickness of 1/2 inch. Quantities exceeding 75 pounds per square yard will not be included in the measurement.

Payment for Stone Filled Sheet Asphalt Surface Course will be made at the contract unit price per ton, but within the above requirements for measurement, complete in place, which payment will include proper cleaning of the roadway and all labor, materials, equipment and incidentals to complete the specified work.

**DIVISION 500**  
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## 501 PORTLAND CEMENT CONCRETE PAVEMENT

### 501.01 DESCRIPTION

Work consists of constructing a pavement composed of Portland Cement Concrete, with reinforcement, on a prepared base course, in accordance with these specifications and in conformity with the lines, grades, thicknesses, and cross sections shown in the contract documents or as established by the Chief Engineer.

### 501.02 MATERIALS

- Portland Cement Concrete, Class E – 817
- Welded wire fabric – 812.01
- Tie Rod Assemblies and Tie Rods – 807.04
- Load transfer assemblies – 807.03
- Preformed expansion joint filler – 807.01
- Joint-sealing materials – 807.02(A) or (B)
- Impervious sub-grade materials – 822.14
- Concrete Curing materials and admixtures – 814
- Fly Ash – 801.05

### 501.03 PROPORTIONING

The Contractor shall submit a mix design conforming to 817.01 for the approval of the Chief Engineer. The approved mix design shall not be changed except as provided below.

- (A) **ADJUSTMENT FOR VARIATION IN FINENESS MODULUS (FM).** If the FM of the fine aggregate varies by more than 0.20 from the established value, the mix design shall be adjusted as provided in 817.01.
- (B) **ADJUSTMENT FOR VARIATION IN WORKABILITY.** If it is impossible to obtain PCC of the desired workability with proportions approved by the Chief Engineer, the Contractor shall make such changes in aggregate weights as necessary, provided that in no case shall the cement content originally designated be changed except as provided below.
- (C) **ADJUSTMENT FOR VARIATION IN CONSISTENCY.** If it is found impossible to produce concrete having the required consistency without exceeding the maximum allowable water-cement ratio specified, the cement content shall be increased as directed by the Chief Engineer so that the maximum allowable water-cement ratio will not be exceeded.
- (D) **ADJUSTMENT FOR VARIATION IN YIELD.** If cement content of the PCC determined by AASHTO T 121 varies more than plus or minus 2 percent from the approved design mix, the proportions shall be adjusted by the Contractor and approved

by the Chief Engineer to maintain a cement content within these limits. The water content shall not exceed the maximum approved.

- (E) **ADJUSTMENT FOR NEW MATERIALS.** Change in source or character of the materials shall be made only after tests on trial mixes and with the Chief Engineer's written approval.

Aggregates and Portland Cement shall be proportioned by weight. Water may be proportioned by volume or by weight. Batch weights of aggregates for the concrete shall be corrected for free moisture, as calculated from moisture determinations performed by the Contractor as directed by the Chief Engineer. These moisture determinations shall be made as frequently as deemed necessary by the Chief Engineer.

Suitable means shall be provided for accurately determining the amount of moisture in the aggregates.

#### **501.04 EQUIPMENT**

Equipment and tools necessary for handling materials and performing the work shall be subject to the approval of the Chief Engineer.

PCC Equipment – 905

#### **501.05 PREPARATION OF GRADE**

After the roadbed, including the area that will support the paving equipment, has been graded and compacted, the grade shall be fine graded to correct elevation, extending the work as necessary beyond each edge of the proposed concrete pavement.

Before or after side forms have been securely set to grade, the subgrade or base course shall be brought to the proper cross section. The finished grade shall be maintained in a smooth and compacted condition until pavement is placed.

#### **501.06 SETTING FORMS**

- (A) **BASE SUPPORT.** The foundation under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade. Any grade that at the form line is found below established grade shall be filled to grade with base course material in lifts of 1/2 inch or less for a distance of 18 inches on each side of the base of the form and thoroughly compacted. Imperfections or variations above grade shall be corrected by re-tamping or by trimming as necessary.
- (B) **FORM SETTING.** Forms meeting the requirements of 905.03(A) shall be set at least 200 feet in advance of the point where concrete is being placed. Where local conditions make this requirement impracticable, it may be waived. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically, or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than 3 pins for each 10 foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked, free from play or movement in any direction. On curves having a radius of less than 250 feet, wood forms of dressed, well-seasoned lumber having a nominal thickness of not less than 2 inches and a width not less than the

depth of the pavement to be placed against them may be used subject to the approval of the Chief Engineer.

The forms shall not deviate from true line by more than 1/4 inch or from true grade by more than 1/8 inch at any point. Forms shall be so set that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and coated with a form release agent or oiled prior to the placing of concrete.

- (C) **GRADE AND ALIGNMENT.** The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

#### **501.07 CONDITIONING OF BASE COURSE**

After the forms have been finally set, the elevation of the entire base course shall be tested by means of an approved template meeting the requirements of 905.04 held in a vertical position and moved backward and forward on the forms. Any excess material indicated by the template shall be removed and depressions shall be filled with approved material. After these adjustments have been made, the base course within the forms shall be compacted in accordance with 209.06. If construction methods are used that involve moving heavy equipment over the prepared base course resulting in heaving or rutting of the base course, the base course shall be protected by mats or boards. The prepared base course shall be maintained, compacted, and shaped to drain at all times.

When directed by the Chief Engineer, the Contractor shall furnish and apply waterproofing materials in accordance with 608 upon the roofs and walls of all structures such as cellars, vaults, elevators, and coal chutes that may be encountered in any type of work. Materials shall be as specified in 802.06. Prior to waterproofing, all joints in the structure shall be sealed in accordance with 501.19. Payment for waterproofing and sealing joints will be included under the PCC pavement item.

After the base course has been constructed and before the concrete is placed, the base course shall be entirely covered with a layer of impervious material meeting the requirements of 822.14.

Impervious material shall be lapped at least 12 inches at the ends and sides. After being placed on the base course, the impervious material shall be maintained reasonably intact and shall not be damaged.

Poles, manholes, or other structures projecting through the concrete shall be given a heavy coating of asphalt meeting the requirements of 802.04 or 802.05 prior to placing the concrete.

#### **501.08 HANDLING, MEASURING AND BATCHING MATERIALS**

The supplier of the concrete shall have sufficient plant capacity and transportation apparatus to provide delivery at the rate required to insure that the depositing of the concrete will be continuous.

Stockpiles of aggregate shall be constructed on areas that are hard, well drained, and denuded of vegetation. Stockpiles shall be built up in layers of not more than 3 feet in thickness. Each layer shall be completely in place before beginning the next, which shall not be allowed to cone down over the next lower layer. Aggregates from different sources and of different gradings shall not be stockpiled together.

Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to minimize segregation of the material. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain high or non-uniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the Chief Engineer.

The fine aggregate and each size of coarse aggregate shall be separately weighed into hoppers in the respective amounts conforming to the approved mix design. Cement shall be measured by weight. Separate scales and hoppers shall be used for weighing the cement with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. Batching shall be so conducted as to result in weights of each material required within tolerances of 1 percent for cement and 2 percent for aggregates. The accuracy of measuring the water shall be within a range of error of not over 1 percent.

Unless otherwise permitted by the contract, batching plants shall be equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocked proportioning devices of approved type.

Methods and equipment for adding air-entraining agents or other admixtures to the batch shall be approved by the Chief Engineer, when required. All admixtures shall be measured into the mixes within a tolerance of plus or minus 3 percent.

### **501.09 MIXING CONCRETE**

The method of mixing shall be approved by the Chief Engineer prior to the start of concrete work.

**(A) GENERAL.** The concrete may be mixed wholly or in part in paving mixers, stationary mixers or truck mixers located at a central plant or at the site. Ready-mixed concrete shall conform to the requirements of AASHTO M 157.

Concrete mixed under these specifications shall be of uniform consistency and such that the mortar will cling to the coarse aggregate. It shall not be sufficiently wet to flow readily or segregate, nor shall it be of a mealy or too dry consistency.

The interval between batches shall be such that the concrete in place does not partially harden and in no case shall this interval exceed 30 minutes. The time interval between admission of cement to the aggregate and final discharge of the concrete shall not exceed one and one-half hours. The time interval shall not exceed one hour for hot weather (85°F or above) construction.

Concrete that becomes non-plastic, unworkable, or outside the limits of the slump specified shall not be used. Concrete which has developed an initial set shall not be used. Re-tempering of partially set concrete by mixing with additional water is prohibited.

Delivery of concrete materials shall be controlled by tickets issued to the driver at the plant. These tickets shall contain information as directed by the Chief Engineer. Upon arrival at the job site, the tickets shall be given to the Chief Engineer.

**(B) TRUCK MIXING.** Truck mixers shall meet the requirements of 905.02.

All wash water shall be dumped before reloading the truck with concrete or concrete materials. No truck shall be loaded which contains free water in the drum. In depositing aggregates into the mixer drum, and in fastening the charging gate, no free water in excess of that found in the moisture determinations shall be admitted into the mixer drum.

Mixing water and wash water for truck mixed PCC shall be stored in watertight tanks, separate from the mixing drum, and shall be equipped with an approved, operable, calibrated gauge on each tank. Water tanks shall be completely filled at plant. If, on arrival at the job, inspection reveals a drop in the water level, the batch may be rejected. All mixing water, other than free moisture in the aggregates, shall be added to the mix in the presence of the Chief Engineer. Prior to adding mixing water to the drum the mixing water gauge valves shall be set to show the water level in the tank, and the gauge shall be read and recorded in the presence of the Chief Engineer. No wash water shall be used until all concrete in the drum has been discharged.

The Contractor shall provide a level area for all truck mixing.

After all materials, including water, have been added to the mixing drum, mixing shall be in accordance with latest recommendations of the mixer manufacturer for a minimum of 70 and a maximum of 100 revolutions excluding revolutions at the agitation speed. The mixing speed shall not be less than 4 rpm and not more than 18 rpm.

If the slump is less than that desired, additional water may be added if permitted by the Chief Engineer. After addition of the water, the mixing drum shall be rotated 20 to 30 revolutions at the mixing speed before the discharge of the concrete. After the addition of water the number of revolutions shall not exceed 100, except for concrete mixes containing coarse aggregates which do not wear more than 25 percent as determined in accordance with Resistance to Abrasion of Small Size Coarse Aggregate, AASHTO T96, for which the number of revolutions shall not exceed 130.

The rate of discharge of concrete from the mixer drum shall be controlled by the speed of rotation in the discharge direction with the discharge gate fully open.

**(C) TRANSIT MIXING.** Transit mixing shall be in accordance with 501.09(B) except:

Mixing water shall be accurately measured at the proportioning plant and added to the mixing drum at the plant. Mixing may be done at the plant or at the job site, at the option of the Contractor. In either case, the mixer drum shall be rotated at the agitation speed from the time the truck leaves the plant until it arrives at the job site.

- (D) **CENTRAL MIXING.** When central mixing is used, the proportioning and mixing plant shall meet all the requirements governing the handling, proportioning and mixing of concrete materials in a stationary mixer in conformance with AASHTO M 157.

The mixed concrete shall be conveyed from the central mixing plant to the site of the work in agitator or nonagitator trucks conforming to 905.02. The time elapsing from the time cement is added to the mix until the concrete is deposited in place at the site work shall not exceed 45 minutes when the concrete is hauled in nonagitating trucks, nor 90 minutes when hauled in truck mixers or truck agitators, except that in hot weather (85°F or above) the time interval shall not exceed one hour.

- (E) **PAVING MIXERS.** Paving mixers having a rated capacity of 27 cubic feet or over may be used when approved by the Chief Engineer.
- (F) **HAND MIXING.** Hand mixed batches of concrete may be allowed only in an emergency. The total quantity of such batches shall not exceed 1/2 cubic yard. Hand mixing shall be subject to the immediate direction and approval of the Chief Engineer.

#### 501.10 LIMITATIONS ON MIXING

- (A) **NIGHT WORK.** Concrete shall be placed during daylight hours unless otherwise permitted by the Chief Engineer. If the placement of concrete is permitted at night, an adequate lighting system shall be provided for both placement operations and inspection testing. A minimum of 20 foot-candles illumination at the slab elevation shall be provided at all areas within both the placement and testing site. The Contractor shall provide a suitable light meter to the Chief Engineer for approval. In addition, before any initial slab placement operation, a test run shall be made to insure that the specified illumination is provided. If a portable generator is used, an emergency backup generator shall be available at the job site.

- (B) **TEMPERATURE AND WEATHER CONDITIONS.** The temperature of the mixed concrete shall not be lower than 50°F and not more than 90°F at the time of placement.

- (1) **COLD WEATHER.** Cold weather is defined as any time during the concrete placement or curing period that the ambient temperature, as given by The U.S. Weather Bureau, at the work site drops below 35°F, or the ambient temperature at the work site drops below 50°F for a period of 24 hours or more.

No concrete shall be placed on frozen sub-grade or base course nor shall frozen aggregates be used in the concrete.

When cold weather is reasonably expected or has occurred within 7 days of anticipated concrete placement, the Contractor shall submit a detailed plan for producing, transporting, placing, protecting, curing and temperature monitoring of the concrete during cold weather. Procedures for accommodating abrupt changes in weather conditions shall be included. Concrete placement shall not commence until approval is given by the Chief Engineer.

All materials and equipment required for protection shall be available at the work site prior to cold weather concrete placement.

All snow, ice and frost shall be removed from the surfaces, including reinforcement and base course, against which fresh concrete is to be placed. The temperature of any surface that will come into contact with fresh concrete shall be at least 35°F and shall be maintained at a temperature of 35°F or above during the placement of concrete.

When the forecast indicates that the temperature is expected to drop below 35°F or be less than 50°F during the 24 hour period following the placing of the concrete, the following conditions shall be met:

- (a) A Type C accelerator meeting the requirements of 814.05(A) shall be incorporated in the concrete mix at the batching plant. Calcium Chloride shall not be used.
- (b) As soon as the concrete has hardened sufficiently to prevent marring, and after curing materials have been placed, all surfaces and edges shall be covered with an insulation blanket conforming to 814.02(D) or other suitable material. Proper provisions shall be made to hold the material in place for at least 72 hours or until tests of field cured flexural strength beams indicate that the concrete has attained 450 psi flexural strength.

The Contractor shall furnish and place continuously recording surface temperature measuring devices that are accurate within  $\pm 2^\circ\text{F}$ .

No direct payment will be made for incorporating an accelerator in the concrete or for the insulated curing required for cold weather construction. The cost of this work will be included in the contract unit price for the various portland cement concrete pay items.

The Contractor will be held responsible for any defective work caused by frost or by freezing. Concrete damaged in any manner shall be removed and replaced at the Contractor's expense

- (2) **HOT WEATHER.** Hot weather is defined as any time during the concrete placement or curing period that the ambient temperature, as given by The U.S. Weather Bureau, at the work site is above 90°F.

In hot weather, all surfaces that come into contact with fresh concrete shall be cooled to below 90°F by covering with approved materials or by other approved methods

If the required consistency cannot be maintained, the mix shall be adjusted in accordance with 501.03. The temperature of the cement at the time of batching shall not exceed 160°F.

### 501.11 PLACING AND CONSOLIDATING CONCRETE

The concrete shall be deposited on the grade in such manner as to require as little rehandling as possible and to prevent segregating of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Spreading shall be accomplished with a mechanical spreader as specified in 905.05. Necessary hand spreading shall be done with square-faced shovels, not rakes or hoes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Where concrete is to be placed adjoining a previously constructed lane of pavement and heavy equipment will be operated upon the existing lane of pavement, the concrete in that lane shall have attained a flexural strength of 550 psi or a compressive strength of 3500 psi. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 3 days. Equipment that will damage the surface of the existing pavement will not be permitted. Concrete hauling units will not be allowed to operate over the base course when, in the opinion of the Chief Engineer, they will damage or change the uniformity of the base course.

Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by approved methods.

All concrete shall be consolidated with spud vibrators meeting the requirements of 905.07. Concrete shall be thoroughly consolidated throughout the entire slab. The vibrator shall not come into contact with the joints, load transfer devices, side forms or the base course. In no case shall the vibrator be operated longer than 5 seconds in any one location. When fabric or bar mat reinforcement is placed by mechanical equipment that uses vibration or a tamping action, other vibratory equipment may be eliminated except in areas adjacent to side forms. Any evidence of honeycombing or lack of consolidation shall be sufficient reason to require removal and replacement of the concrete at the Contractor's expense.

Concrete shall be deposited as near to the expansion joints as possible without touching them. It shall then be shoveled against both sides of the joint simultaneously, maintaining equal pressure on both sides. Care shall be taken that it is worked under the load transfer devices. The concrete shall not be dumped directly upon or against the joints, nor shall it be shoveled or dropped directly on top of the load transfer devices. In placing the concrete against expansion and contraction joints and in operating a vibrator adjacent to them, workmen shall avoid stepping upon or disturbing in any way the joints or load transfer devices, either before or after they are covered with concrete. Concrete shall be placed over and around dowels in a manner so that dowels are fully embedded without displacement. If any of the dowel bars are displaced, they shall be realigned before the finishing machine passes over them.

#### **501.12 STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT**

Following the placing of the concrete, it shall be struck off with a mechanical spreader meeting the requirements of 905.05 to conform to the cross section or typical section shown on the plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be reasonably close to the elevation shown on the plans or as established by the Chief Engineer. Reinforced concrete pavement shall be placed in two layers. The entire width of the bottom layer shall be struck off and consolidated to such length and depth that the sheet of fabric conforming to 812.01 may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, screeded and consolidated. Any portion of the bottom layer of concrete that has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

Reinforcing steel shall be straight and its surface condition shall be free from dirt, oil, paint, grease, loose mill scale and loose or thick rust which could impair the bond of the steel with the concrete.

Unless otherwise shown on the plans, wire fabric reinforcement conforming to approved standards and design requirements shall be used in PCC pavement 6 inches or greater in thickness.

The sheets of reinforcement shall be tied at the laps so as to be held in place and shall extend to within 2 inches of the ends of the slabs and to within 2 inches of the edges of the slab or through the cement concrete curbing to within 2 inches of the back of the curb when the curb is poured monolithically with the slab. Reinforcement shall not extend across expansion joints, contraction joints or planes of weakness. Wire fabric reinforcement shall be placed approximately 2 inches below the finished surface of the slab with the larger wires running in the longitudinal direction or as indicated in the plans.

Additional reinforcement meeting the above specifications shall be placed over cuts as directed by the Chief Engineer. Additional wire fabric reinforcement, when used, shall be placed approximately 2 inches above the bottom of the slab. This work shall be considered "Additional Wire Fabric Reinforcement."

### 501.13 FINAL STRIKE-OFF, CONSOLIDATION AND FINISHING

- (A) **GENERAL.** The sequence of operations shall be the strike-off, consolidation, floating, removal of laitance, straight edging and final surface finishing. Work bridges or other devices necessary to provide access to the pavement surface for the purpose of finishing, straight edging and making corrections as hereinafter specified, shall be provided by the Contractor.

Finishing machines meeting the requirements of 905.06 shall be used to finish the pavement.

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted.

- (B) **MACHINE FINISHING.** The concrete shall be distributed or spread as soon as placed, consolidated in conformance with 501.11 and 501.12 and struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper consolidation and leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling or other variation affecting the precision finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length.

If a uniform and satisfactory density of concrete is not obtained at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and use methods that will produce pavement conforming to the requirements specified herein at his own expense.

- (C) **FINISHING AT JOINTS.** The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, also under and around all

load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as specified.

After the concrete has been placed and vibrated adjacent to the joints, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated coarse aggregate shall be removed from both sides of and off the joint. The screed shall be lifted and brought across the joint. The forward motion of the finishing machine shall then be resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated coarse aggregate immediately between the screed or on top of the joint.

After the concrete has been placed on both sides of the joint and struck off, the installing bar or channel cap shall be slowly and carefully withdrawn, leaving the preformed filler in place. After the installing bar or channel cap is completely withdrawn, a tapered wooden strip shall be temporarily inserted in the joint, and freshly mixed concrete shall be worked into any depressions left by the removal of the installing bar. The installing bar shall be cleaned and oiled prior to each installation of a joint.

- (D) HAND FINISHING.** Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:
- (1) In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs. Narrow widths, areas of irregular dimensions or areas where operation of mechanical equipment is impractical, may be finished by hand methods.
  - (2) When finishing by hand is permitted, the concrete shall be placed to the full thickness required in successive batches for the entire width between construction joints shown on the plans. The concrete shall be vibrated internally during placing as specified herein, and shall be screeded off with a steel shod screed weighing not less than 15 pounds per linear foot. The screed shall be constructed so that it can be set accurately to whatever roadway crown is required. It shall be operated by a sawing motion and moved forward on substantial screed supports set at proper elevations. The shape and construction of the screed shall meet the approval of the Chief Engineer. The screeding shall be repeated, as required, accompanied by tamping, or other operations necessary to provide an even, approved surface ready for floating.
- (E) FLOATING AND REMOVAL OF LAITANCE.** After screeding is completed, the surface shall be floated with a float meeting the requirements of 905.09(C). The float shall be operated transversely with a combined longitudinal and transverse motion and with a sufficient number of passes to smooth all ridges and fill all depressions. Excess water and soupy material shall be wasted over the forms at each pass.
- (F) STRAIGHTEDGING AND SURFACE CORRECTION.** After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface shall be tested in accordance with 501.16. Depressions shall be immediately filled

with freshly mixed concrete, struck off, consolidated, refinished and retested. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures, and the slab conforms to the required grade and cross section.

- (G) **FINAL SURFACE FINISH.** After the concrete has been floated and the surface corrected, it shall be finished by dragging the surface in a longitudinal direction with burlap meeting the requirements of 814.01. This drag shall be worked with a longitudinal motion, care being used not to permit the edges to dig into the surface of the concrete or to work the crown out of the pavement.

After the water sheen has practically disappeared, but previous to any initial set, the surface shall be given the final finish by brooming with a broom meeting the requirements of 905.09(D). The broom shall be moved from one side of the pavement to the other without interruption. The travel of the broom shall overlap a small amount. The brooming shall be perpendicular to the center line of the pavement and so executed that the corrugations thus produced will be of uniform character and width and not more than 1/8 inch in depth, with the resulting surface free from objectionable depressions or projections that might be formed by improper handling. The brooming must be completed before the edges of the pavement and joints are rounded.

The surface of the pavement adjacent to all curbs, i.e., in the flow line of the gutter, shall be troweled and finished with hair brooms or hair brushes conforming to 905.09(D) or (E).

- (H) **EDGING AT FORMS AND EXPANSION JOINTS.** All joints and edges shall be rounded to 1/4-inch radius.

#### 501.14 JOINTS

- (A) **GENERAL.** Longitudinal and transverse joints shall be located and constructed as shown on the contract documents. All joints shall be perpendicular to the pavement surface and perpendicular, radial, or parallel to the roadway centerline or as directed.

The sequence of construction of various slabs shall be determined by the Contractor with the approval of the Chief Engineer.

- (B) **LONGITUDINAL JOINTS.** Longitudinal joints shall be either formed or sawn. Joints between separately constructed roadway slabs and curb and gutter sections shall be formed. Longitudinal center joints shall be installed in a manner so that full contact is made at intersections with transverse joints. Longitudinal joints shall have tie rods or keyways and tie rod assemblies meeting the requirements of 807.04, constructed and spaced as shown in the contract documents. No tie device shall be placed closer than 18 inches to a transverse joint.

The initial installation of the tie rod assembly shall be firmly held in place by tap bolts and steel washers. Tap bolts shall be in place during the fine grading. The tap bolts shall then be removed and the remainder of the tie rod assembly installed.

The edges of the slab first constructed shall be given a heavy coating of bituminous material meeting the requirements of 802.04 or 802.05 prior to pouring the adjacent slab.

### (C) TRANSVERSE JOINTS

- (1) **GENERAL.** No transverse joint shall be formed within 10 feet of an existing pavement, bridge or approach slab. Expansion joints shall be placed 10 feet back from the end of the new pavement where it abuts an existing pavement.
- (2) **TRANSVERSE EXPANSION JOINTS.** Transverse expansion joints shall be composed of load transfer assemblies conforming to 807.03, and 3/4 inch thick preformed joint filler conforming to the requirements of 807.01. Transverse expansion joints shall be constructed and placed as shown in the contract documents.

Unless otherwise shown on the plans, expansion joints shall be placed at each end of a block, at tangent points of curves and/or curb corners and at intervals of approximately 360 feet. The Chief Engineer may require the spacing of joints to vary at intersections, islands, and circles or other similar locations.

Joints shall be constructed perpendicular to the centerline of the pavement so as to produce straight joints within an allowable variation of 1/4 inch in 10 feet and a discrepancy with the pavement surface of not more than 1/8 inch in 10 feet. The joint will be checked with a 10 foot straightedge.

The joint filler shall be securely held in place to insure against displacement during construction and the top edge of the filler shall be protected with a U-shaped metal cap while the concrete is being placed and finished. The joint filler shall be punched to admit dowel bars and to assure a tight fit.

The preformed expansion joint filler shall be continuous across the full width of the pavement and through the curb and gutter and shall extend from the base course to 1/2 inch below the finished pavement surface.

Where joint filler is joined to the joint filler of an adjacent, previously constructed slab, a perfect butt fit shall be accomplished or a U-piece of thin gage metal shall be placed to prevent the infiltration of cement mortar into the joint. Any section of expansion joint filler extending through any curb shall be so cut that the elevation of the top of the joint filler shall be 1/2 inch below the finished surface of the curb. The filler so cut shall be in one piece except when the curb is superimposed, in which case that portion above the flow-line level of the gutter may be a separate piece securely aligned and constructed so that it will function properly as an expansion joint and that the top seal will be watertight. The expansion joint filler shall conform to the section of the pavement where thickened edges are used.

After the concrete is cured and as soon as the forms for longitudinal construction are removed, the ends of all expansion joint filler shall be cleaned of concrete and the full width of the filler exposed for the full depth of the slab. No concrete shall be placed adjacent to a previously poured slab until the ends of the filler have been cleaned. The ends of the joint filler in the next slab to be poured shall be placed neatly and firmly against previously placed joint filler.

- (3) **TRANSVERSE CONTRACTION JOINTS.** Transverse contraction joints shall be constructed and located as shown in the contract documents or as directed by the Chief Engineer.

Any section of the contraction joint extending through the curb shall be formed as specified in 609.01(E) (6).

- (4) **TRANSVERSE CONSTRUCTION JOINTS.** Transverse construction joints shall be formed where it is necessary to stop placing concrete for 30 minutes or longer, by staking in place a timber bulkhead of the same depth as the thickness of the concrete at right angles to the slab and finishing the concrete to the bulkhead. Tie rod assemblies shall be placed in transverse construction joints as shown in the contract documents. Where the location of the construction joint coincides with that of the expansion joint, the expansion joint shall be constructed with load transfer devices. If, due to an emergency, concrete placement must be stopped within less than 10 feet of a previously formed transverse joint, the concrete shall be removed to the joint prior to continuing the pouring of the slab.

- (D) **SAWN JOINTS.** Longitudinal or transverse contraction joints may be sawn when permitted by the Chief Engineer. The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions and at the required rate to control cracking. The Contractor shall provide adequate artificial lighting facilities for night sawing. The grooves shall be cut to a minimum depth of 2 inches and the width shall be the minimum width possible with the type of saw being used, but in no case shall exceed 1/4 inch.

All joints shall be sawn before uncontrolled shrinkage cracking takes place and shall be regulated so that each joint is sawn 4 to 24 hours after placement of concrete. If necessary, the sawing operation shall be performed day and night, regardless of weather conditions. The concrete shall have hardened sufficiently to permit sawing without damage by blade action to the pavement surface or to concrete adjacent to the joint. Slight, though not excessive, raveling will be permissible along the joint edge. They shall be completed before placing concrete in the succeeding adjacent lane. The sawing of any joint shall be omitted if a crack occurs over load transfer devices prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. In general, all joints shall be sawn in sequence.

The slabs on either side of longitudinal joints shall be tied together by the installation of 1/2 inch tie rods 30 inches long placed across the longitudinal joint to a depth below the proposed saw cut and spaced in accordance with the contract documents. The tie rods shall be placed in a manner satisfactory to the Chief Engineer. No tie rod shall be placed closer than 18 inches to a transverse joint.

- (E) **LOAD TRANSFER ASSEMBLY.** All transverse expansion joints shall be provided with means for load transfer meeting the requirements of 807.03.

When dowel bars are used, they shall be of the sizes as shown on the standard drawings or contract documents, and shall conform to the requirements of 807.03(B). The dowels shall not be placed closer than 6 inches to a longitudinal joint. A dowel sleeve conforming to the requirements of 807.03 shall be placed on the greased end of each dowel.

The assembly shall be rigidly installed in a manner approved by the Chief Engineer. The dowels shall be rigidly held in place parallel to the surface and center line of the pavement by supports that do not permit displacement by workmen or otherwise during construction. A tolerance of not more than 1/8 inch in 12 inches from correct alignment, either vertical or horizontal, will be permitted.

Special care shall be taken with the base course to establish the required cross section at the locations where assemblies are to be installed. If, for any reason, the base course is trimmed too low, or if there are any open spaces beneath the assembly, the assembly shall be removed, the base course backfilled, tamped firmly and the assembly reset.

### 501.15 TESTING

The consistency of the concrete will be checked by the slump test in conformance with AASHTO T 119. The slump shall not exceed 3". The determination will be made when and as often as deemed necessary by the Chief Engineer to check the consistency of the concrete. The Contractor shall provide a slump cone, rod and a flat, non-absorbent surface in conformance with AASHTO T 119, for each project.

Test cylinders and beams will be made from each class of concrete, at the direction of the Chief Engineer. One set of concrete test specimens shall be made for every 50 cubic yards of concrete placed. Concrete for such specimens shall be furnished by the Contractor as directed.

Concrete test specimens for both compression strength testing and for flexural strength testing shall be made and cured in accordance with AASHTO T 23. Unless otherwise specified, the minimum 28 day compressive strength shall be 3500 psi. Flexural strength shall be tested in conformance with AASHTO T 177. Flexural strength shall be as hereinafter specified. The Contractor shall provide cylinder curing facilities at the project site in conformance with AASHTO T 23. Immediately after molding and finishing, the concrete specimens shall be stored up to 48 hours in concrete curing box with pre-set temperature controls and in an environment to prevent moisture loss from the specimens. The cylinders should be placed in a thermostatically climate controlled storage chest with adjustable temperature controller for heating or cooling and the temperature shall be maintained between 60° F and 80° F. Listed below are two pre-approved concrete curing boxes:

Forney Model No. LA-1302

Humboldt Model No. H-2968

Curing boxes other than these listed must be submitted to and approved by the Chief Engineer prior to use.

The Contractor shall transport PCC specimens to DDOT Materials Testing Facility in accordance with AASHTO T 23, Transportation of Specimens to Laboratory

Air content of plastic concrete shall be tested in conformance with AASHTO T 196 or AASHTO T 152 as determined by the Chief Engineer. The entrained air shall be 5 to 8 percent by volume.

The Contractor shall furnish and maintain for the concrete phase of the contract two pressure air type meters with necessary accessories meeting the requirements of AASHTO T 152, Type B. The air meter shall be properly calibrated by an independent laboratory with a

certification furnished to the Chief Engineer. The Contractor shall also furnish the Engineer with and maintain two (2) concrete thermometers meeting the requirements of AASHTO T-309.

**(A) ACCEPTANCE.** Concrete acceptance shall meet the requirements of 817.04.

If concrete fails to provide the designated concrete strength, the Chief Engineer shall make a determination of acceptance, rejection or acceptance at a reduced price. If the concrete is accepted at a reduced rate, the applicable rate will be calculated as per (B) Price Adjustment. Replacement of deficient concrete shall be at the Contractor’s expense.

**(B) PRICE ADJUSTMENT.** Payment for concrete that fails to meet minimum acceptance levels for strength will be adjusted according to the following formula:

$$\text{Pay Adjustment} = \frac{-2(f'_c - f_c)(\text{PAB})(Q)}{f'_c}$$

- where  $f'_c$  = Specified minimum compressive strength measured in psi
- $f_c$  = Compressive strength as determined by acceptance tests in psi
- PAB\* = Price Adjustment Base
- Q = Quantity of concrete represented by acceptance tests in cubic yards

\*PAB is the Contract unit price for the class of concrete involved. Where the Contract basis of payment is other than by unit price, PAB is \$800.00.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Class A Concrete	Cubic Yard
Class B Concrete	Cubic Yard
Class C Concrete	Cubic Yard
Class D Concrete	Each, per pre-stressed member
Class E Concrete	SY/CY as per pay item
Class F Concrete	SY/CY as per pay item
Class H Concrete	Cubic Yard
Class I Concrete	Cubic Yard
Class J Concrete	Square Yard

**501.16 SURFACE TESTING**

The finished surface of the pavement shall conform to the grade, alignment and cross-section specified. The surface shall be tested with a straightedge meeting the requirements of 903.03 laid parallel to the center line of the pavement. Any deviation of the pavement surface in excess of 1/8 inch in 10 feet shall be immediately corrected. Extreme care shall be exercised to see that there is no deviation at joints. The Contractor shall be held responsible for the trueness of the surface of the pavement and shall be required to correct any deviation from the alignment, grade and cross-section as specified. Dusting with cement or sprinkling with water will not be permitted.

**501.17 CURING**

The concrete shall be cured by one of the methods listed below.

- (A) **MEMBRANE COMPOUND CURING.** Membrane curing compound conforming to 814.03 shall be applied immediately after the final finishing of the surface by means of a mechanical sprayer conforming to 905.08. The curing compound shall be applied with an overlapping coverage that will give a two coat application at coverage of not more than 150 square feet per gallon for both coats. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be stirred continuously by effective mechanical means. Spraying pressure shall be sufficient to produce a fine spray and cover the surface thoroughly and completely with a uniform film. The application of curing compound by hand operated pressure sprayers will be permitted only on odd widths or shapes of slabs and on concrete surfaces exposed by the removal of forms, as authorized by the Chief Engineer. When application is made by hand operated sprayers, the second coat shall be applied in a direction approximately at right angles to the direction of the first coat.

The compound shall form a uniform, continuous, coherent film that shall not check, crack or peel and shall be free from pin holes and other imperfections. If pin holes or other discontinuities exist, an additional coat shall be applied within 30 minutes to the affected areas. Concrete surfaces that are subject to heavy rainfall within three hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above, at no additional cost to the District.

Necessary precautions shall be taken to insure that none of the curing compound enters joints that are to be sealed. Rope of moistened paper, fiber or other suitable material shall be used to seal the top of the joint opening, and the concrete in the region of the joint shall be sprayed with curing compound immediately after the rope seal is installed. Other methods of protecting the joints may be used when approved by the Chief Engineer.

Approved standby facilities or approved alternate methods for curing concrete pavement shall be provided at a readily accessible location at the site of the work for use in event of mechanical failure of the spraying equipment or any other conditions which may prevent correct application of the membrane curing compound at the proper time. In the event of a failure of the regular spraying equipment, the paving operation shall be suspended and the standby or alternate curing method shall be used only on the remaining portion of the pavement already placed.

When the air temperature will reach 90° F or above, 2 layers of water-saturated burlap shall be placed over the concrete after the application of the curing compound. The burlap shall be placed in accordance with the requirements for burlap curing and shall be kept wet for 24 hours.

- (B) **BURLAP CURING.** Burlap meeting the requirements of 814.01 shall be placed as soon as it may be done without injury to the concrete. It shall be overlapped in half widths of strips so as to provide a double thickness throughout its coverage. It shall be saturated prior to placement and placed wet. It shall be kept wet continuously for a minimum of 72 hours.

After the initial 72-hour period, the burlap may be removed providing that the concrete has developed a flexural strength of 450 psi as ascertained by testing in accordance with 501.15. If flexural strength tests are not made, or if the tests indicate strengths less than

450 psi, the concrete shall be cured an additional 4 days. The burlap shall be kept wet during the entire 7 day period.

The burlap shall be free from holes, earth or any substance that will interfere with its absorptive qualities or have a deleterious effect on the concrete. Any burlap that becomes contaminated with earth or other deleterious substances shall be washed clean prior to use.

- (C) **POLYETHYLENE SHEETING OR WATERPROOF PAPER CURING.** As soon after finishing as practical without marring the surface, the pavement shall be covered with polyethylene sheeting conforming to 814.02(A) or waterproof paper conforming to 814.02(B). The cover shall be of sufficient width to provide a complete cover for the surface of the pavement, including face and top of all curbs and the edges of the pavement or curb when the forms are removed. The cover shall be carefully placed as directed to completely seal the surface without marring it. The cover shall be secured along the sides and ends to maintain a reasonably airtight seal and adjoining covers shall overlap at least 12 inches. Any material that is torn or does not provide an acceptable airtight seal shall not be used.

The concrete shall be kept covered a minimum of 72 hours. After the initial 72 hour period, the covering may be removed provided that the concrete has attained a flexural strength of 450 psi as ascertained by testing in conformance with 501.15. Otherwise, the concrete shall be kept covered 7 days.

#### **501.18 REMOVING FORMS AND BACKFILLING**

- (A) **REMOVAL OF FORMS.** Forms shall not be removed in any case in less than 12 hours, and during periods of low temperatures (below 40° F), they shall not be removed in less than 48 hours. Forms shall be removed carefully to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured by one of the methods specified in 501.17. Honeycombed areas will be considered defective work and shall be removed and replaced as directed by the Chief Engineer.
- (B) **BACKFILLING.** Where concrete pavements are constructed without curbs, backfilling shall be performed within 24 hours after removal of the forms and shall consist of preparation of the shoulder adjacent to the pavement. Where concrete pavements are constructed with curbs, backfilling shall be done in accordance with 609.01(E) (7).

#### **501.19 SEALING OF JOINTS**

- (A) **TRANSVERSE JOINTS.** All transverse expansion, contraction and construction joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including the Contractor's equipment. The sealing material shall conform to 807.02(A) (1) or (2).

Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing, and the joint faces shall be clean and the surface dry when the seal is applied.

Cleaning shall be accomplished by the use of power tools approved by the Chief Engineer. The use of any tools that result in damage to the pavement will not be

permitted. Immediately prior to the actual sealing operation, the joints shall be thoroughly blown out with a jet of air having sufficient volume and pressure to remove any loose material left by the cleaning operation.

When hot poured-type joint sealing material is used, it shall be heated to the temperature recommended by the manufacturer, but not to exceed 450° F at any stage during the melting or pouring operations, in an approved melting- applicator apparatus meeting the requirements of 903.02.

The sealing material shall be applied to each joint opening to conform to the details shown on the plans or as directed by the Chief Engineer. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur. Any material heated beyond the recommended pouring temperature shall be rejected and removed from the apparatus, the apparatus thoroughly cleaned and new material heated to the proper temperature. Only sufficient material for the day's operations shall be heated at a time. When it is necessary to cut material into small chunks before putting it into the apparatus, the method used shall be approved by the Chief Engineer.

The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

The joints shall be filled to within 1/4 inch of the finished pavement surface and the sealing material so placed that the resulting stripe will be straight and neat.

The use of sand or similar material as a cover for the seal will not be permitted. Poured joint sealing material shall not be placed when the air temperature in the shade is less than 50° F, unless approved by the Chief Engineer.

- (B) LONGITUDINAL JOINTS.** When the edge of the first of separately constructed adjacent slabs is given a heavy coating of bituminous material as required in 501.14(B) it shall constitute the sealing of the longitudinal construction joint.

### **501.20 PROTECTION OF PAVEMENT**

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen and flaggers to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges or crossovers.

In order that the concrete may be properly protected against the effects of rain or other abrupt changes in weather conditions before it has attained final set, the Contractor shall have covering material available at the work site.

The Chief Engineer will carefully consider any damage to the pavement occurring prior to final acceptance and may allow the Contractor to repair such damage or require the damaged pavement to be replaced.

### **501.21 OPENING TO TRAFFIC**

Vehicular traffic shall be excluded from pavement and pavement repairs for a minimum of 72 hours after the placement of curing materials. After the initial 72-hour period, if approved

by the Chief Engineer, the pavement may be opened to traffic providing that the concrete has developed a flexural strength of 550 psi or a compressive strength of 3500 psi as by testing in accordance with 501.15. If strength tests are not made, or if the required strengths are not attained, traffic shall be excluded for a minimum of 7 days after the concrete was placed.

The pavement shall be cleaned and all joints sealed prior to opening to traffic.

The cost of steel plating, if needed, shall be paid for as specified in 616.19.

### **501.22 HIGH EARLY STRENGTH CONCRETE**

All specifications for standard Portland Cement Concrete shall apply to high early strength concrete. High early strength concrete shall be produced by one of the following methods, or a combination thereof, as directed by the Chief Engineer.

1. By the use of high early strength Portland Cement in lieu of the standard Portland cement specified and in the same amount.
2. By the use of additional standard Portland Cement (the total amount of cement shall not exceed 1 bag over that required by the approved mix design).
3. By the use of a Type C accelerator meeting the requirements of 814.05 incorporated in the concrete mix.
4. By ready mix design approved by the District Department Of Transportation Materials Division that shall be measured and paid in a similar method as Reinforced PCC Pavement.

Where the use of high early strength cement or additional standard cement is directed, the purpose being to produce a high early strength concrete to allow for earlier opening or completion of the project, the Contractor will be required to proceed with diligent prosecution of all phases of the work to insure the full benefit of the additional cost and an early opening.

Should the Contractor fail, refuse or neglect to complete the work properly and diligently so as to render it ready for traffic, such failure, refusal or neglect shall be sufficient reason to withhold payment for high early strength cement or the additional standard cement.

### **501.23 TOLERANCE IN PAVEMENT THICKNESS**

The thickness of the constructed pavement will be determined by average caliper measurement of cores measured in accordance with AASHTO T 148. At such points as the Chief Engineer may select, in each 500 linear lane feet or fraction thereof of pavement, 2 or more cores will be taken and measured. These cores will be taken by the District. The average thickness of each 500 feet of pavement will be determined from these cores. In calculating the average thickness of the pavement, measurements that are in excess of the thickness specified by more than 1/8 inch will be considered as the specified thickness plus 1/8 inch. Measurements that are less than the specified thickness by 1/2 inch or more shall not be included in the average. Disposition of pavement deficient by 1/2 inch or more in thickness will be as provided below.

For pavement slabs, the average thickness of which is 1/8 inch less than the thickness specified, the contract unit price shall be used in the payment.

For pavement slabs, the average thickness of which is less than the thickness specified by more than 1/8 inch, but less than 1/2 inch, an adjusted unit price shall bear the same ratio to the contract unit price as the square of the average thickness of the slab bears to the square of the thickness specified.

Additional payment over the contract unit price will not be made for any pavement with an average thickness in excess of the thickness specified.

The adjusted unit price shall be calculated for each 500 feet or fraction thereof in which the deficient core lane measurements are included.

Payment will not be made for pavement that is deficient by 1/2 inch but less than 1 inch in thickness. Such pavement shall either be removed and replaced with pavement of specified thickness at the Contractor's expense, or may remain in place without payment to the Contractor. Pavement deficient by 1 inch or more in thickness shall be removed and replaced at the Contractor's expense.

Where the specified method of determining thickness reveals pavement deficient in thickness by 1/2 inch or more, additional cores shall be made at intervals of 25 feet parallel to the centerline to determine the extent of the deficiencies greater than 1/2 inch. Determination of the extent of the areas to be replaced and/or areas for which no payment will be made will be based on these additional thickness determinations.

If the Contractor believes that the cores and measurements taken are insufficient to indicate fairly the actual thickness of pavement, he may request additional cores and measurements. Such measurements shall be at intervals not less than 200 feet. The cost of additional cores and measurements shall be deducted from sums due the Contractor unless such measurements indicated that the pavement within the area in question is of specified thickness.

The Contractor shall fill test holes with the same type of concrete as in the pavement.

#### **501.24 MEASURE AND PAYMENT**

Payment for the various items of work listed herein will include all costs for furnishing all materials, labor, tools, equipment and incidentals to complete the work.

##### **(A) REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT** (Square Yard Method).

The unit of measurement for Reinforced PCC Pavement will be the square yard. The actual number of square yards of the specified depth measured complete in place will be paid for at the contract unit price per square yard, or adjusted unit price per square yard if required under 501.23, which payment will include joints, waterproofing, load transfer devices, impervious material, reinforcement, sealing of joints and curing.

The width for measurement will be the width from the intersection of the face of the curb or gutter with the surface of the pavement on one side to the intersection of the face of the curb or gutter with the surface of the pavement on the other side. Where there is no curb or gutter, the width for measurement will be from outside edge to outside edge of the pavement. The length will be the actual length measured along the center line of the riding surface.

- (B) **REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT** (Cubic Yard Method). The unit of measure for Reinforced PCC Pavement will be the cubic yard. The actual number of cubic yards complete in place will be paid for at the contract unit price per cubic yard, or adjusted unit price per cubic yard if required under 501.23, which payment includes joints, waterproofing, load transfer devices, impervious material, reinforcement, sealing of joints and curing.
- (C) **PORTLAND CEMENT CONCRETE**. The unit of measure for PCC will be the cubic yard. The actual number of additional cubic yards furnished complete in place for extra depth of concrete over trenches, around manholes, thickened edges, or for other use, as directed by the Chief Engineer, will be paid for at the contract unit price per cubic yard.
- (D) **ADDITIONAL WIRE FABRIC REINFORCEMENT**. The unit of measure for Additional Wire Fabric Reinforcement will be the square yard. The actual number of square yards measured complete in place, with no allowance for overlap, will be paid for at the contract unit price per square yard for the appropriate item listed in the Schedule of Prices.
- (E) **EXTRA PREFORMED EXPANSION JOINT**. No separate payment will be made for preformed expansion joint material; it will be included in the payment of the appropriate PCC items.
- (F) **HIGH EARLY STRENGTH PORTLAND CEMENT**. The unit of measure for High Early Strength Portland Cement will be the bag. The actual number of bags incorporated in the mix in lieu of standard Portland cement will be paid for at the contract unit price per bag, which payment shall be for the additional cost of high early strength Portland cement over that of standard Portland cement.
- (G) **HIGH EARLY STRENGTH PORTLAND CEMENT CONCRETE PAVEMENT**. (Cubic Yard Method). The unit of measure for High Early Strength PCC Pavement will be the cubic yard. The actual number of cubic yards complete in place will be paid for at the contract unit price per cubic yard, or adjusted unit price per cubic yard if required under 501.23, which payment includes joints, waterproofing, load transfer devices, impervious material, reinforcement, sealing of joints and curing.
- (H) **ADDITIONAL STANDARD PORTLAND CEMENT**. The unit of measure for Additional Standard Portland Cement will be the bag. The actual number of bags of additional cement added to the mix at the direction of the Chief Engineer for the purpose of producing high early strength concrete will be paid for at the contract unit price per bag.

## 502 PORTLAND CEMENT CONCRETE BASE

### 502.01 DESCRIPTION

Work consists of constructing a base composed of Portland Cement Concrete, with or without wire fabric reinforcement, on the prepared base course in accordance with the contract documents. Except as herein stated, all requirements specified for 501 are applicable to this specification.

Work also includes PCC for miscellaneous uses, thickened section of alley and drive entrances, bulkheads and various incidental repairs as determined by the Chief Engineer.

### 502.02 CONSTRUCTION REQUIREMENTS

Construction methods shall conform to 501 with the following exceptions, changes or additions.

#### (A) TRANSVERSE JOINTS.

(1) **TRANSVERSE EXPANSION JOINTS.** When the temperature at the time of placing base concrete is 50°F or higher, expansion joints shall be omitted. When the temperature at the time of placing base concrete is lower than 50°F, preformed expansion joint filler 1/2 inch in thickness and meeting the requirements of 807.01 shall be installed in the concrete base at each end of the project and at intervals of approximately 360 feet or at intersections as directed by the Chief Engineer. Joints installed at the end of the project shall be placed at least 10 feet from the end of the existing pavement. The expansion joint filler shall be placed flush with the surface of the finished base and shall extend the full width and depth of the slab. Expansion joints shall be provided with means for load transfer meeting the requirements of 807.03. It will be necessary to round the edges of the joint faces of Portland cement concrete base.

(2) **TRANSVERSE CONTRACTION JOINTS.** Weakened plane transverse contraction joints in the concrete base to be covered with asphaltic material may be constructed in accordance with 501.14(C)(3); or after the concrete has been placed and floated, a groove shall be cut in the concrete to a depth of 2-1/2 inches, a fiber strip inserted into this groove and placed flush with the top of the concrete base, and the concrete finished over the newly formed joint. Joints need not be edged or sealed. These joints shall be placed approximately but not more than 20 feet apart. Load transfer devices will not be required.

(B) **SEALING OF JOINTS.** Unless otherwise directed, sealing of joints in concrete base to be covered with asphaltic materials will not be required. Covering the base with asphaltic material shall constitute sealing.

(C) **FINISHING.** In finishing Portland Cement Concrete base, any deviation of the base surface in excess of 1/4 inch from the straightedge shall be immediately corrected.

**502.03 MEASURE AND PAYMENT**

Payment for the various items of work listed herein will include all costs for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

- (A) **PORTLAND CEMENT CONCRETE BASE** (Square Yard Method). The unit of measure for Portland Cement Concrete Base will be the square yard. The actual number of square yards of the specified depth measured complete in place will be paid for at the contract unit price per square yard, or adjusted unit price per square yard if required under 501.23, which payment will include joints waterproofing, load transfer devices, impervious material, reinforcement and curing.

The width for measurement will be the width from the intersection of the face of the curb or gutter with the surface of the base on one side to the intersection of the face of the curb or gutter with the surface of the base on the other side. Where there is no curb or gutter, the width for measurement will be from outside edge to outside edge of the base. The length will be the actual length measured along the center line of the riding surface.

- (B) **PORTLAND CEMENT CONCRETE BASE** (Cubic Yard Method). The unit of measure for Portland Cement Concrete Base will be the cubic yard. The actual number of cubic yards complete in place will be paid for at the contract unit price per cubic yard, or adjusted unit price per cubic yard if required under 501.23, which payment includes joints, waterproofing, load transfer devices, impervious material, reinforcement if specified and curing.

## 503 REINFORCED PORTLAND CEMENT CONCRETE ALLEY

### 503.01 DESCRIPTION

Work consists of constructing an alley composed of PCC with wire fabric reinforcement on a prepared base course in accordance with the contract documents. Except as herein stated, all requirements specified for 501 are applicable to this specification.

### 503.02 CONSTRUCTION REQUIREMENTS

Construction methods shall conform to the requirements specified in 501 with the following exceptions, changes, or additions.

- (A) **DESIGN.** Reinforced Portland Cement Concrete Alley shall be constructed in one slab the full width of the alley.
- (B) **PLACING CONCRETE.** A mechanical spreader will not be required in placing concrete.
- (C) **PLACING REINFORCEMENT.** Wire fabric reinforcement conforming to approved standards and design requirements shall be placed in 6 to 8 inch alleys.
- (D) **FORMING JOINTS.** Transverse expansion joints shall be placed at approximately 40 foot intervals.

Transverse contraction joints shall be placed at approximate intervals of 13 feet between the transverse expansion joints. These contraction joints shall consist of a groove formed with a jointing tool with a blade projection not less than 1-1/2 inches. As an alternate method, sawn joints will be permitted and shall be done in accordance with 501.14 (D).

Longitudinal joints will not be required in this type construction.

- (E) **LOAD TRANSFER DEVICES.** Load transfer devices shall be 3/4 inch in diameter.
- (F) **FINISHING.** A finishing machine will not be required.

### 503.03 MEASURE AND PAYMENT

The unit of measure for Reinforced Portland Cement Concrete Alley will be the square yard. The width for measurement will be from outside edge to outside edge of the alley. The length will be the actual length measured along the center line of the riding surface.

The actual number of square yards of the specified depth, measured complete in place will be paid for at the contract unit price per square yard, which payment will be full compensation for furnishing, hauling and placing all materials including joints, load transfer devices, reinforcement, impervious material, sealing of joints, curing and for furnishing all equipment, tools, labor and incidentals necessary to complete the work as specified herein.

## 504 PCC DRIVEWAY AND ALLEY ENTRANCES

### 504.01 DESCRIPTION

Work consists of constructing driveway and alley entrances composed of Portland Cement Concrete with wire fabric reinforcement on prepared base courses in accordance with the contract documents. Except as herein stated, all requirements specified for 501 are applicable to this specification.

### 504.02 CONSTRUCTION REQUIREMENTS

Construction methods shall conform to the requirements specified in 501 with the following exceptions, changes, or additions.

- (A) **PLACING CONCRETE.** When the driveway and alley entrances abut other permanent structures such as Portland Cement Concrete pavement, bases, sidewalks, alleys, and driveways, 1/2-inch thick preformed expansion joint filler meeting requirements of 807.01 shall be installed between the driveway and alley entrance and the permanent structure.

A mechanical spreader will not be required for placing the concrete.

- (B) **PLACING REINFORCEMENT.** Wire fabric reinforcement conforming to approved standards and design requirements shall be placed in driveways and alley entrances 6 inches in thickness or greater, in a manner conforming to the requirements specified in 501.12.
- (C) **FORMING JOINTS.** Expansion and contraction joints shall be installed in driveways and alley entrances per 501.14 or as directed by the Chief Engineer.
- (D) **FINISHING.** A finishing machine will not be required for this type of work.

### 504.03 MEASURE AND PAYMENT

Payment for the various items of work listed herein will include all costs for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

- (A) **PCC DRIVEWAY AND ALLEY ENTRANCES (Square Yard Method)** – The unit of measure for PCC Driveway and Alley Entrances will be the square yard. The actual number of square yards of the depth specified, measured complete in place, will be paid for at the contract unit price per square yard, which payment will include expansion joint filler, waterproofing, impervious material, wire fabric reinforcement and curing.
- (B) **PCC DRIVEWAY AND ALLEY ENTRANCES (Cubic Yard Method)** – The unit of measure for PCC Driveway and Alley Entrances will be the cubic yard. The actual number of cubic yards, measured complete in place, will be paid for at the contract unit price per cubic yard, which payment will include expansion joint filler, waterproofing, impervious material, wire fabric reinforcement and curing.

## 505 PCC PAVEMENT REPLACEMENT

### 505.01 DESCRIPTION

Work consists of the cutting, removal and disposal of defective areas or other areas of existing PCC pavement, base, alley, driveway and alley entrances and the replacing with PCC meeting the requirements of the specifications for new construction of a similar type or as directed by the Chief Engineer.

### 505.02 MATERIALS

Portland Cement Concrete – 817, Class E

Welded wire fabric – 812.01

Tie rod assemblies and tie rods – 807.04

Load transfer assemblies – 807.03

Preformed expansion joint filler – 807.01

Joint-sealing materials – 807.02(A) or (B)

Impervious subgrade materials – 822.14

Concrete Curing materials – 814

Fly Ash – 801.05

### 505.03 PROPORTIONING

The proportions of materials for concrete shall meet the requirements of 817. Adjustments may be made as provided in 501.03.

### 505.04 CONSTRUCTION REQUIREMENTS

Pavement replacement shall conform to the requirements of the specifications for new construction of a type similar to that being replaced with the following exceptions, changes or additions.

- (A) **PREPARATION FOR CONCRETE REPAIRS.** The replacement area shall be prepared by removing all necessary materials as directed by the Chief Engineer. The area shall be graded to the depth necessary to replace the pavement so that it will meet the requirements of the specifications for new construction of a similar type. If unsuitable material is discovered in the base course, it shall be removed and replaced with material conforming to 804.04. Measure and payment for the removal will be made under 202 and for the new material under 209.
- (B) **PLACING CONCRETE.** The edges of the concrete adjoining the repair shall be thoroughly cleaned prior to depositing fresh concrete against them. Wire fabric reinforcement meeting the requirements of 812.01 for the type pavement being repaired shall be used in the replacement of pavement, base and alley, if such pavement, base, or alley is reinforced or if directed by the Chief Engineer. Any damaged expansion joint

material in the area to be repaired shall be replaced with new material and shall conform in all respects as to type, quality, and method of installation to that of new construction.

- (C) **CUTTING TO A NEAT LINE.** The perimeter of all repair areas shall be cut to a neat line to a depth of 2 inches by means of a power saw.

#### **505.05 MEASURE AND PAYMENT**

- (A) **PORTLAND CEMENT CONCRETE PAVEMENT REPLACEMENT.** The unit of measure for PCC pavement, of the type and depth designated, will be the square yard. The actual number of square yards measured complete in place will be paid for at the contract unit price per square yard, which payment will include sawing, removal and disposal of excavated materials, curing, protection, and all labor, materials tools, equipment and incidentals necessary to complete the work as specified herein.
- (B) **WIRE FABRIC REINFORCEMENT FOR PORTLAND CEMENT CONCRETE PAVEMENT, BASE AND ALLEY REPAIR.** The unit of measure for Wire Fabric Reinforcement for Portland Cement Concrete Pavement, Base and Alley Repair will be the square yard. The actual number of square yards measured complete in place will be paid for at the contract unit price per square yard, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.
- (C) **ANCHOR BOLTS – PAVING.** The unit of measure of Anchor Bolts-Paving will be each. The actual number of anchor bolts complete in place will be paid for at the contract unit price per each, which payment will include drilling of holes, and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

## **506 REPAIR OF PCC PAVEMENT, BASE, ALLEY, DRIVEWAY AND ALLEY ENTRANCES**

### **506.01 DESCRIPTION**

Work consists of making repairs to PCC pavement, base, alley and driveway and alley entrances and includes the cutting, removal and disposal of the old material from cuts or openings for underground work to a depth equal to that of the surrounding concrete, or as directed by the Chief Engineer. Unless otherwise mentioned in Section 506 or in the contract documents, materials, construction and methods and measure and payment shall meet the requirements specified for new construction of a similar type.

Work also includes replacing adjacent areas of defective pavement in a manner described above.

### **506.02 MATERIALS**

Portland Cement Concrete – 817, Class E

Welded wire fabric – 812.01

Tie rod assemblies and tie rods – 807.04

Load transfer assemblies – 807.03

Preformed expansion joint filler – 807.01

Joint-sealing materials – 807.02(A) or (B)

Impervious sub grade materials – 822.14

Concrete Curing materials – 814

Fly ash – 801.05

### **506.03 PROPORTIONING**

The proportions of materials for concrete shall meet the requirements of 817. Adjustments may be made as provided in 501.13.

### **506.04 CONSTRUCTION REQUIREMENTS**

The Contractor shall not make pavement excavation or openings to a greater extent than can be replaced and repaved during the same working day, unless otherwise approved by the Chief Engineer.

PCC repair shall conform to the requirements of the specifications of new construction of a type similar to that on which the repairs are to be made, with the following exceptions, changes, or additions.

- (A) PREPARATION FOR CONCRETE REPAIRS.** The areas to be repaired shall be prepared by removing all materials as directed by the Chief Engineer. The area shall be graded to the depth necessary to construct the repair so that it will meet the requirements of the specifications for new construction of a similar type. If unsuitable materials are discovered in the base course, it shall be removed and replaced with material conforming

to 804.04 and measured and paid for under 209. The area of repair will be such as to provide on each side of the cut a minimum 6-inch shoulder on undisturbed base course.

The concrete adjoining the section to be replaced shall be left with reasonably straight edges. Repair sections shall be in accordance with the standard drawings. If it is necessary to make replacement closer than 2 feet to a joint or to an existing repair, the replacement shall be extended to the joint and/or the existing repair as directed by the Chief Engineer.

All costs of cutting back, removal, and disposal of the excavated material to the depth of pavement which is to be placed shall be included in the contract unit price for Repair PCC Pavement, base, alley, driveway and alley repair. Material to be removed above or below the pavement will be paid for at the contract unit price under 202.

When directed by the Chief Engineer, the asphalt binder course shall be omitted from the repair area and replaced with base concrete. This is intended for small repairs where it is impractical to compact the binder course with a roller. The elevation of the finished concrete base shall be sufficiently below the pavement surface to allow placing and proper compaction of the specified thickness of the asphalt surface course.

- (B) **CUTTING TO A NEAT LINE.** The perimeter of all repair areas that become part of the permanent roadway surface shall be cut to a neat line by means of a power saw.
- (C) **PLACING CONCRETE.** The edges of the concrete adjoining the repair shall be thoroughly cleaned and wetted just prior to depositing fresh concrete against them. Wire fabric reinforcement meeting the requirements of 812.01 for the type pavement being repaired shall be used in the repair of pavement, base and alley, if such pavement, base, or alley is reinforced or if directed by the Chief Engineer. Any damaged expansion joint material in the area to be repaired shall be replaced with new material and shall conform in all respects as to type, quality, and method of installation to that of new construction. Sufficient carbon powder shall be used in the repair of pavement, alley and sidewalk so that the repaired area will closely match the color of the existing concrete. The cost of furnishing carbon powder for pavement and alley repair will be paid for at the contract unit price per pound for carbon powder for PCC pavement and alley repair.

If sufficient concrete is not available to completely fill the repair section, bulkhead timber of the depth of the repair shall be placed to receive the concrete. Tie rods shall be placed in the concrete at approximately 1/2 the depth of the repair and shall be embedded 1/2 the length of the rod.

Tie rods for this purpose shall meet the requirements of 807.04 except that a length of only 20 inches will be required.

When truck-mixed concrete is used for repair, re-tempering the concrete and placing of concrete that has attained initial set will not be permitted. However, in lieu of the time interval requirements of 501.09, the interval between the admission of cement to the batch and final discharge shall not exceed 2 hours.

It is important that all locations at which concrete is to be used are fully prepared prior to delivery of the concrete and that only sufficient concrete is ordered to permit its use within the time limit specified for hauling concrete. Due to the difficulty of placing concrete in irregular and small repairs, and the importance of attaining the best possible

results, the Contractor shall proceed with the utmost diligence in the prosecution of all phases of work.

- (D) **PROTECTION.** In lieu of the provisions specified in 501.20 and 501.21 the following shall apply: All classes of traffic shall be excluded from pavements by the erection and maintenance of suitable barricades for a period of 24 hours after placing the concrete. This curing period will be increased to 48 hours in the case of roadway and alley construction during the period classified as Cold Weather Construction.

On heavily traveled streets, a steel protection plate, per 616.19, extending out onto the adjoining pavement at least 6 inches on all sides may be required over concrete base repair areas. The plates shall be securely anchored to prevent displacement under traffic. When steel protection plates are used, barricades will not be required.

The Contractor shall be responsible for the cuts and their condition from the initiation of excavation to the removal of barricades from completed repair.

- (E) **TREE SAFEGUARDS.** Tree safeguards shall conform to the requirements of 611.07 and 611.08.

#### 506.05 CLEANING UP

The Contractor shall remove from the roadway all excavated pavement, debris, and dirt as rapidly as the completion of the repair work permits, and in no case will it be permissible for this material to remain on the project overnight.

#### 506.06 MEASURE AND PAYMENT

- (A) **PORTLAND CEMENT CONCRETE PAVEMENT, AND ALLEY REPAIR.** The unit of measure for Portland Cement Concrete Pavement, Base and Alley Repair will be the cubic yard. The actual number of cubic yards measured complete in place will be paid for at the contract unit price per cubic yard, which payment will include sawing, removal and disposal of excavated materials, backfill, joint materials, load transfer devices, placement of dowels, tie rods and tie bars, curing, protection, joint sealing and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.
- (B) **WIRE FABRIC REINFORCEMENT FOR PORTLAND CEMENT CONCRETE PAVEMENT, BASE AND ALLEY REPAIR.** Measure and payment for Wire Fabric Reinforcement for Portland Cement Concrete Pavement, Base and Alley Repair will be made in accordance with 505.05(B).
- (C) **ADDITIONAL STANDARD PORTLAND CEMENT.** The unit of measure for Additional Standard Portland Cement will be the bag. The actual number of additional bags added to the mix, as directed by the Chief Engineer per 501.22, will be paid for at the contract unit price per bag, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.
- (D) **CARBON POWDER.** The unit of measure for Carbon Powder will be the pound. The actual number of pounds added to the mix will be paid for at the contract unit price per pound, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

**DIVISION 600**  
**INCIDENTAL CONSTRUCTION**

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- 611.01 Removal of Trees And/Or Stumps
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- 618.19 Drawings-Permit Application for Repairs in the Streetlighting System
- 618.20 Install Underground Streetlight Cables
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- 618.27 Streetlight Base – Breakaway and Steel
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## 601 INCIDENTAL CONCRETE CONSTRUCTION

### 601.01 BUS STOP PADS, MEDIAN STRIPS, AND ISLANDS

- (A) **DESCRIPTION.** Work consists of PCC bus stops, median strips, directional islands for channelization of traffic, and pedestrian islands, constructed on bituminous pavement, PCC pavement, or on a prepared base course in conjunction with new construction. Except as herein stated, all requirements specified in Section 501 for “Reinforced Portland Cement Concrete Pavement” are applicable to this specification.
- (B) **MATERIALS.** The materials shall meet the requirements specified in 501.02.
- (C) **COMPOSITION.** The proportions of materials for concrete shall meet the requirements of 817, Class E.
- (D) **TESTING.** The concrete shall meet the requirements of 501.15.
- (E) **CONSTRUCTION REQUIREMENTS.** Construction shall conform to the requirements described in 501 with the following exceptions, changes, or additions:
- (1) **PREPARING PAVEMENT FOR BUS STOP PADS.** Where bus stop pads are to be constructed on composite pavement, the bituminous surface course and binder course shall be removed and the area of the concrete base on which the islands are to be constructed shall be cleaned and roughened as directed by the Chief Engineer.
  - (2) **PREPARING PAVEMENT OR BASE COURSE FOR MEDIAN STRIPS, OR DIRECTIONAL AND PEDESTRIAN ISLANDS.** Where the medians or islands are to be constructed on composite pavement, the bituminous surface course and binder course shall be removed and the area of the concrete base on which the medians or islands are to be constructed shall be cleaned and roughened as directed by the Chief Engineer.

Where the medians or islands are to be constructed on PCC pavement, a groove 1 foot wide, 2 inches deep and approximately 6 feet in length shall be cut into the surface of the existing pavement at intervals of 6 feet for the full length of the island and shall be on the approximate center line of the proposed location of the island. The surface shall be thoroughly cleaned before placing concrete.

When islands are to be constructed on the base course or in conjunction with new construction, the work shall be done in accordance with requirements for new reinforced PCC pavement or sidewalk construction, whichever, as determined by the Chief Engineer, is applicable, except that the density of the base course shall not be less than 95 percent of maximum density.

- (3) **REINFORCEMENT.**
  - (a) **Bus Stop Pads.** When bus stop pads are constructed on a base course and extend for the full depth of the pavement, wire fabric reinforcement weighing 50 pounds per 100 square feet shall be used. When the bus stops are constructed upon concrete base previously placed, wire fabric reinforcement weighing 30 pounds per 100 square feet shall be used.

- (b) Median Strips, Directional and Pedestrian Islands. Wire fabric reinforcement weighing 30 pounds per 100 square feet shall be placed in the medians or islands approximately 2 inches below the surface and shall extend for the full width and length thereof.
- (4) **PLACING ANCHOR SOCKETS.** Anchor sockets for reflector posts shall be installed in the directional and pedestrian islands or medians as shown on the plans. They shall be placed in such a manner as to project above the surface for a distance of 2 inches. The cost of this work shall be included in the contract unit price per cubic yard for concrete for construction of bus stops, median strips, directional islands and pedestrian islands.
- (5) **FORMING JOINTS.** Where PCC bus stop pads, median strips, directional islands, or pedestrian islands are constructed upon PCC pavement or base, the joints in the bus stop pads, medians, or islands shall be placed at the same locations and be of the same type as the joints in the pavement or base. Where the bus stop pads, medians or islands are constructed upon base course, the joints shall be placed at the same locations, and be of the same type as the adjacent concrete against which the bus stops or islands are placed.
- (6) **SEALING JOINTS.** All joints in bus stop pads, median strips, directional islands, and pedestrian islands shall be sealed in conformance with 501.19.
- (7) **FINISHING.** Bus stops shall be finished in accordance with the requirements specified in 501.13. The surface of the islands shall be finished in accordance with 608.01(C) (6) except that the surface shall not be marked in 3 foot squares nor will transverse contraction joints be formed at 12 foot intervals. The faces of the islands and median strips shall be finished in accordance with the requirements specified in 609.01(E) (9).
- (F) **MEASURE AND PAYMENT.** The unit of measure for PCC Bus Stop Pads, Median Strips, Directional Islands, and Pedestrian Islands will be the cubic yard. The number of cubic yards of concrete computed from field measurements will be paid for at the contract unit price per cubic yard, which payment will include furnishing, hauling, and placing all materials, including joints, reinforcement, sealing of joints, and curing, and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

## 602 MINOR STRUCTURES

### 602.01 WALLS AND STEPS

#### (A) DESCRIPTION.

- (1) **CONCRETE FOOTINGS.** This work shall consist of excavating, forming, furnishing and placing concrete footings for concrete and stone masonry walls to the dimensions and at the locations as designated in the contract documents and/or as directed by the Chief Engineer.
- (2) **CONCRETE WALLS.** This work shall consist of excavating, forming, furnishing and placing concrete on concrete footings, and backfilling of concrete walls, at the locations and to the dimensions as specified in the contract documents and/or as directed by the Chief Engineer.
- (3) **STONE MASONRY WALLS.** This work shall consist of excavating, furnishing and placing stone on the concrete footings, and backfilling of stone walls at the locations and to the dimensions as specified the contract documents and/or as directed by the Chief Engineer.
- (4) **CONCRETE STEPS.** The work shall consist of excavating, forming, furnishing and placing concrete for steps at the locations and to the dimensions as specified in the contract documents and/or as directed by the Chief Engineer.

#### (B) MATERIALS

Concrete (Steps) – 817, Class F

Concrete (Footings and Walls) – 817, Class B

Pervious fill – 805.02

Backfill – 804.04

Facing Stone for the wall, if required, shall be sound and durable, subject to approval of the Chief Engineer. It shall be gray granite, free from reeds, rifts, laminations and minerals which would cause discoloration or deterioration, and shall be 40 percent seam face and 60 percent split face of a light color.

Before proceeding with the work, the Contractor shall submit for approval the name of the quarry and 2 samples of the stone proposed to be used in the work. One sample shall show the lightest color and the other shall show the darkest color of the stone to be furnished. All stone in the work shall be within the color range defined by the approved samples and of the same type of stone. The samples shall have a face size of at least 6 inches by 6 inches.

Stones for wall facing shall have a minimum depth of 6 inches. Stone shall range in rise from a minimum of 4 inches to a maximum of 12 inches, with an average rise of not less than 8 inches. Exposed surfaces shall have stones with a ratio of length to rise of not less than 1-1/2 to 1 and no more than 4 to 1, with the exception of closure stones. A minimum number of closures, not exceeding 5 percent of the exposed surface of the work, may be placed. Closures shall be rectangular with the longest face laid horizontal.

Stone shall be 1-1/2 inch rock faced, i.e., the face shall be an irregular convex protecting surface without indications of tool marks, with no concave surfaces below the pitch line, and with no projections beyond the pitch line exceeding 1-1/2 inches.

Coping Stones shall be sound, durable, properly quarried gray granite free from reeds, rifts, seams, laminations and minerals, which by weathering would cause discoloration or deterioration. Before proceeding with the work, the Contractor shall submit for approval the name of the quarry and 2 samples of the stone proposed for use in the work. The samples, each having a face size of at least 2 inches by 6 inches, shall show the texture, color range, and finish of the stone to be furnished. All stone in the work shall be of the same kind and color range as defined by the approved samples. All dimensions shall conform to those shown on the plans unless otherwise ordered by the Chief Engineer. The minimum length of coping stone shall be 3 feet.

The top and roadway sides of coping shall be sawn. All sawn surfaces shall be sandblasted after tooling and dressing. The backside of the coping shall be coarse pointed, with the point depressions approximately 1 to 1-1/4 inches apart with surface variations not to exceed 3/8 inch. Joint faces shall be vertical and at right angles with the exposed faces of the stone.

Backing Stones shall be sound, durable stone subject to approval of the Chief Engineer.

Mortar for stone masonry walls – 806.05(B) (1) and (2)

Reinforcing steel for steps – 812.02

**(C) CONSTRUCTION REQUIREMENTS.**

- (1) **CONCRETE FOOTINGS.** Construction shall conform to the applicable provisions of 205, 206, and 703.
- (2) **CONCRETE WALLS.** Construction shall conform to the applicable provisions of 205, 206, and 703.
- (3) **STONE MASONRY WALLS.** Construction shall conform to the applicable provisions of 205, 206, and 708 for Class B stone masonry except as herein noted.

Beds and joints shall be pointed to produce a concave surface from stone to stone approximately 1/4 inch in depth.

The coping stone shall be set on the top of the stone masonry wall on a mortar bed 1/2 to 1 inch in thickness and shall be anchored to the top of the wall by wrought iron or galvanized iron dowels 3/4 inch diameter, 6 inches long, one at each end of each coping stone. Joints for coping shall be not less than 1/4 inch nor more than 1/2 inch with an average of 3/8 inch. The Contractor shall exercise care in the setting of the coping course so that the stones present smooth and uniform line and grade.

- (4) **CONCRETE STEPS.** Construction shall conform to the applicable provisions of 205, 206, and 703 except as herein noted. Reinforcing steel, when specified in the contract documents, shall be placed in conformance with 704.

Where the steps are to be constructed on existing ground, the ground shall be neatly graded to required elevation and dimensions as shown in the contract documents, and care shall be exercised to assure that the ground to receive the concrete is

undisturbed and is kept dry. The concrete shall be poured as soon as practicable after excavation is complete and the forms erected. Forms shall remain in place for at least 24 hours after the concrete is poured, unless permission for an earlier removal is granted by the Chief Engineer.

The treads of the steps shall be broomed with a stiff brush to some uniform pattern to provide a roughened surface that will not be slippery when wet.

**(D) MEASURE AND PAYMENT.**

- (1) **CONCRETE FOOTINGS.** The unit of measure for Concrete Footings will be the cubic yard. The actual number of cubic yards measured complete in place, or, if the footing is poured against side excavation computed based on plan dimensions, will be paid at the contract unit price per cubic yard, which payment will include all excavation and disposal of surplus material and all labor, materials, tools, equipment and incidentals necessary to complete the work.
- (2) **CONCRETE WALLS.** The unit of measure for Concrete Walls will be the cubic yard. The actual number of cubic yards measured complete in place will be paid at the contract unit price per cubic yard, which payment will include all excavation and disposal of surplus material, pervious fill and backfilling materials, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.
- (3) **STONE MASONRY WALLS.** The unit of measure for Stone Masonry Walls will be the cubic yard. The actual number of cubic yards of stone masonry complete in place, measured in the field will be paid at the contract unit price per cubic yard, which payment will include all excavation and disposal of surplus materials, pervious fill and backfilling materials, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.
- (4) **CONCRETE STEPS.** The unit of measure for Concrete Steps will be the cubic yard. The actual number of cubic yards of concrete measured complete in place, or, if the steps are poured against side excavation, computed based on plan dimensions, will be paid at the contract unit price per cubic yard, which payment will include all excavation and disposal of surplus material, backfilling materials, reinforcing steel when specified and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

**602.02 PORTLAND CEMENT CONCRETE COPINGS**

- (A) **DESCRIPTION.** This work shall consist of the construction of standard and special copings to the dimensions and at the locations as indicated on the contract plans and/or as directed by the Chief Engineer.
- (B) **MATERIALS.** The copings shall be constructed of concrete conforming to PCC Mix Design, Class F as per 817, with materials meeting the requirements of 501.02.
- (C) **CONSTRUCTION REQUIREMENTS.** Construction of copings shall conform to the requirements of 501 with the following exceptions, changes or additions.
  - (1) **FORMS.** Forms for this work shall meet the requirements of 905.03(B) with the following exceptions, changes or additions:

- (a) Backforms for both standard and special copings shall be of a depth equal to the depth of the coping.
  - (b) A front form will not be required for standard copings, but a method as approved by the Chief Engineer shall be employed to achieve the end product of an 8 inch radius on the front face of the coping as shown on the contract plans.
  - (c) Front forms for special copings shall be required, shall be of a depth equal to the depth of the coping and shall be so equipped that the grooves and bevel are formed as shown on the contract plans.
- (2) **PLACING CONCRETE.** The concrete for standard copings shall be placed against the back form and thoroughly compacted by working with suitable tools. Care shall be exercised in depositing the concrete so that it reaches a position in the forms so that it can be finished to the required dimensions with a minimum of working. It shall be compacted to insure a smooth, even surface free from voids and honeycombs. The plastering of honeycombed areas will not be permitted.
- Concrete for special copings shall be placed in accordance with the requirements specified in 609.01(E) (2).

- (3) **FORMING JOINTS.** Where the standard or special concrete coping is to be poured adjacent to a cement concrete sidewalk, the expansion joints and planes of weakness joints shall be formed at the same intervals and in line with the transverse joints in the sidewalk. Where the coping does not abut any sidewalk or any other concrete slab, the expansion joints shall be formed at 45 foot intervals with planes of weakness at intervals of 15 feet. Where shorter sections are necessary for closures, no section shall be less than 4 feet.

Where the copings terminate at alleys, driveways, or other permanent structures, expansion joint filler having a recovery of 90 percent or more shall be installed at the junction. Expansion joints shall be constructed with a single piece of joint filler meeting the requirements of 807.01(A), cut to the dimensions of the coping. Intermediate transverse joints shall be formed as specified in 608.01(C)(6) when the coping is poured integrally with the sidewalk. When the coping does not abut the sidewalk or any other concrete slab, the plane of weakness joints shall be formed by a bar or plate which can be easily removed without damage to the coping.

- (4) **FINISHING.** The front face of the coping shall be shaped to the required dimensions as soon as possible after the concrete has been deposited and is workable. The front face of the coping shall be finished true to line, grade, and contour in a smooth, neat, and even manner. When the concrete has set sufficiently, the surface shall be brushed with a fine hair brush meeting the requirements of 905.09(E). The top surface of the coping shall be tested with a straightedge meeting the requirements of 903.03 laid along the surface in the longitudinal direction. Any deviation of the top surface of the coping in excess of 3/16 inch from the straightedge shall be immediately corrected. There shall be no variation in alignment of the coping exceeding 1/8 inch. All rejected coping shall be removed and replaced without additional compensation. Back forms shall remain in place for at least 12

hours. Any irregular surface shall be corrected by rubbing with a carborundum stone.

Special concrete coping shall be finished in accordance with applicable requirements of 609.01(E) (9).

- (5) **BACKFILLING.** Backfilling of the coping shall be done to meet the applicable requirements of 609.01(E) (7).

**(D) MEASURE AND PAYMENT.**

The unit of measure for Standard Portland Cement Concrete Coping and of Special Portland Cement Concrete Coping will be the cubic yard. The actual number of cubic yards measured complete in place will be paid for at the respective contract unit price per cubic yard, which payment will include excavation and disposal of material, furnishing, hauling, and placing all materials including joints, curing, backfilling, and all labor, materials, tools, equipment and incidentals necessary to complete the work.

## 603 UNDERDRAINS

### 603.01 DESCRIPTION

Work consists of trench excavation, dewatering, furnishing and placing filler materials including fabric if required, under drain pipe, connecting pipe, pipe risers, and backfill. Work includes all pipe connections plus installation and maintenance of shoring as needed to provide the specified trench width. The Contractor shall make the requisite excavations for constructing the under drain, appertaining structures, and connections and make provisions to maintain and protect fences, trees, underground installations, and other structures. He shall be responsible for the repair of all damage which may result from his operations.

The Contractor shall, after giving due notice to parties affected thereby, provide plank crossings, barricades or other means of maintaining and protecting travel on streets or roads in which trenches are excavated and shall maintain these in good and safe condition so long as may be necessary and shall then remove such temporary expedients and restore such ways to their proper condition.

Work shall include furnishing all materials, tools, labor, and equipment required to fully install and make operational the entire drainage system.

If the Chief Engineer determines that sufficient and proper shoring is not provided, extra shoring shall be installed at the Contractor's expense.

### 603.02 MATERIALS

Materials shall meet the following requirements:

Pervious fill – 805.02

Under drain pipe – 808.02(B), 808.03 or 809.02

Connecting pipe – 808.01(A) or 808.02(A)

Mortar – 806.05(B)(4)

Backfill material – 804 as determined by the depth

Blanket soils – 805.04

PCC for collar and block – 817, Class F

Pipe risers – 808.02(A) or 808.03

Pipe Jointing compound – 822.16

Cleanouts – cast-iron meeting 815.04, Class 30 (they shall have an adjustable housing with countersunk cleanout plug and a scoriated Cast Iron cover)

Coarse Aggregate – 805.03

Geotextile Fabric – 822.09

### 603.03 CONSTRUCTION REQUIREMENTS

Trenches shall be excavated to the dimensions and grade as specified in the contract documents, standard drawings or as directed by the Chief Engineer. The sides and bottom of trenches shall be smooth and uniform to prevent tearing of geotextile fabric during backfilling.

When specified in the contract documents, geotextile fabric shall be placed tightly against the trench to eliminate voids beneath the geotextile. The geotextile fabric shall be of sufficient width to completely enclose the underdrain trench including any specified overlaps. Wrinkles and folds in the geotextile fabric shall be avoided, except where trench changes direction. Geotextile joints and overlaps shall be a minimum of 24 inches and pinned securely to hold the fabric in place during backfilling. Damaged geotextile fabric shall be replaced or repaired as directed by the Chief Engineer at the expense of the Contractor.

The slope of the underdrain pipe shall be so that positive drainage toward the under drain outlet is maintained. Perforated pipes shall be placed with perforations down. Pipe shall be placed with the bell end up grade. Pipe sections shall be joined with appropriate couplings. The ends of under drain pipe, except for combination under drains, shall be plugged up grade as directed by the Chief Engineer. When an under drain connects with a manhole or catch basin, a suitable connection shall be made through the wall of the manhole or catch basin.

Under drains shall be outletted into drainage structures wherever possible. Outlets that empty into a drainage structure shall be positioned a minimum of 6 inches above the normal flow level in the structure and shall be constructed of under drain pipe. A minimum of 18 inches of cover over the pipe shall be maintained. When outletted to a slope or ditch, the connector pipe shall slope a minimum of 3 % unless otherwise directed by the Chief Engineer. A sloped concrete headwall with removable rodent screen shall be constructed at the end of the connector pipe in conformance with the contract documents.

Pipe used for outlets shall be non-perforated rigid polyethylene or polyvinyl chloride. Flexible tube type pipe is prohibited. Geotextile fabric is prohibited for under drain outlets. Longitudinal under drains shall have outlets spaced at a maximum of 250 feet intervals, unless otherwise directed by the Chief Engineer, and at the lowest elevation on all vertical curves.

After pipe installation has been approved by the Chief Engineer, aggregate backfill shall be placed and compacted. Pipe and covering at open joints shall not be displaced during subsequent operations. The Contractor shall replace any geotextile, under drain or connector pipe damaged by excessive tamping at no additional cost to the District.

### 603.04 MEASURE

- (A) **UNDERDRAINS AND CONNECTOR PIPES.** The unit of measure for Under drains and Connector pipes will be the linear foot. The number of linear feet will be measured along the center line out of the top of the pipe, complete in place. Measure for under drain will be made from the spigot end of the pipe where it enters the bell of the fitting for the connecting pipe. When cleanouts are being installed, the measurement will terminate at the riser; otherwise, it will terminate at the end of the pipe. For connector pipe, measure will be made from the outside face of the headwall, inlet wall or manhole to the bell end of the connecting pipe where it meets the under drain pipes.

- (B) **ADDITIONAL EXCAVATION FOR UNDERDRAINS.** When directed by the Chief Engineer, the additional excavation required to lower the trench to an elevation lower than specified in the contract documents or the standard drawings will be measured and paid as Additional Excavation for Under Drains. The unit of measure for Additional Excavation for Under Drains will be the cubic yard.
- (C) **UNDERDRAIN PIPE RISERS.** The unit of measure of Under Drain Pipe Riser will be the vertical linear foot. The number of vertical linear feet will be measured along the center line on the outside of the pipe.

Measure will be made from the bell end of the under drain pipe where the elbow fits into the bell to the top of the cleanout plug.

### 603.05 PAYMENT

- (A) **UNDERDRAINS & CONNECTOR PIPES.** The number of linear feet of Under drains and Connector Pipes, as measured in 603.04(A), will be paid for at the contract unit price per linear foot, which payment will include excavating to plan depth and width, or as specified herein. This payment will also include disposal of all excess and unsuitable excavated materials, the furnishing, hauling, and placing of all underdrain pipe, connector pipe, and backfill and all labor, geotextile fabric, materials, tools, equipment, and incidentals necessary to complete the work.
- (B) **ADDITIONAL EXCAVATION FOR UNDERDRAINS.** The number of cubic yards of Additional Excavation for Under Drains as measured in 603.04(B), will be paid for at the contract price per cubic yard, which payment will include the excavation and disposal of all excess excavated materials, the furnishing, hauling and placing of all materials including additional pervious materials, and all labor, materials, tools, equipment and incidentals necessary to complete the work.
- (C) **UNDERDRAIN PIPE RISERS.** The number of linear feet of Under Drain Pipe Risers, as measured in 603.04(C), will be paid for at the contract unit price per vertical linear foot which payment will include excavation and disposal of excess and unsuitable materials, the furnishing, hauling, and placement of all materials, including the elbow fitting, the PCC blocks, the cleanout box, and all labor, tools, equipment, and incidentals necessary to complete the work.

## 604 SLOPE AND FOUNDATION PROTECTION

### 604.01 DESCRIPTION

This work consists of constructing a protective covering of grouted riprap or slope paving along embankment slopes, around culvert inlets or outlets, or placing a graded stone mass around foundations or at such locations as directed by the Chief Engineer, in conformance with grades, dimensions, and details indicated in the contract documents.

Work also includes the necessary excavation, shaping and compacting the foundation, trimming, and cleanup.

### 604.02 MATERIALS

Stone for grouted riprap – 803.10

Stone for foundation protection shall be graded from coarse to fine and meet the same requirements for suitability as listed above for riprap stone

Portland cement – 801.01

Mortar sand – 803.06

Water – 822.01

Welded Wire Fabric – 812.01, the weight shall be 30 lbs/100 sq. feet.

### 604.03 CONSTRUCTION REQUIREMENTS

(A) **GENERAL.** Slopes and ground surfaces shall be excavated to lines and grades indicated in the contract documents on plans or as directed by the Chief Engineer.

After this excavation is complete, the area shall be compacted to a density of 93 percent of that determined by AASHTO T 180, Method D. Any poor material shall be removed and suitable fill material placed so that proper compaction can be achieved.

All outer edges and the top of grouted riprap or concrete slope paving, where construction terminates, shall be formed so that surface of the work will be embedded, and even with adjacent slope or ground.

At toe of slopes, the bottom of grouted riprap or concrete slope paving shall be placed at least 3 feet below the finished ground surface unless otherwise indicated.

Construction of all grouted riprap or concrete slope paving shall be started at bottom of slope, progressing upward.

No grouted riprap or concrete slope paving shall be placed during freezing weather nor while there is any ground frost. Cold weather construction shall conform to the requirements of 501.10(B).

Grouted riprap and concrete slope paving shall be covered with 2 layers of burlap, meeting the requirements of 814.01, and kept wet for 3 days after placement.

- (B) **GROUTED RIPRAP.** All stones shall be hand placed substantially in a single layer, with a 12 inch dimension laid perpendicular to the exposed face. As stones are placed, grout shall be deposited to completely fill all voids between stones. Care shall be taken to secure maximum compaction and density.

Depth of riprap shall be as indicated on the plans in the contract documents and shall not vary more than 2 inches  $\pm$ ; average depth shall be not less than stipulated. Surface of the completed work shall have a neat, rustic appearance, and no grout shall be used to cover surface of stone. Variance from the theoretical surface shall not exceed 2 inches in 10 feet and shall be made as smooth as practicable without cutting or breaking stones.

Grout shall be composed of 1 part portland cement, 3 parts mortar sand, measured by volume and thoroughly mixed dry, and a sufficient quantity of water added afterwards to make a paste of such consistency that it will flow and completely fill all voids.

- (C) **SLOPE PAVING.** Slope paving shall be constructed as a single layer, using a single pour between joints, in conformation with grades, dimensions, and details indicated on the plans in the contract documents. Concrete shall meet requirements of 817, Class F and be mixed and placed in accordance with 501, except that volumetric batching may be used.

The concrete shall be finished with a wooden float; all edges shall be neat, using an approved edger.

- (D) **STONE FOUNDATION PROTECTION.** Stone for protection of foundations at abutments, walls, piers, etc., shall be carefully dumped around the foundation, as indicated on the plans or as directed by the Chief Engineer, in such a manner that segregation of the graded stone mass will be kept to a minimum and will produce a reasonably compact and properly sloped mass with minimum voids.

#### 604.04 MEASURE AND PAYMENT

- (A) **GROUTED RIPRAP AND SLOPE PAVING.** The unit of measure for Grouted Riprap and Slope Paving will be the square yard. The actual number of square yards of the specified thickness, complete in place, measured on the exposed surface of the grouted riprap or slope paving will be paid for at the contract unit price per square yard, which payment will include all necessary excavation and its proper disposal, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.
- (B) **STONE FOUNDATION PROTECTION.** The unit of measure for Stone Foundation Protection will be the ton. The actual number of tons complete in place determined by the certified scale weights will be paid for at the contract unit price per ton, which payment will include all labor, materials, tools, equipment, and incidentals necessary to complete the work.

**605 GUARDRAILS AND GUARDRAIL TERMINALS****605.01 GUARDRAIL**

- (A) **DESCRIPTION.** Work shall consist of the fabrication and erection of new guardrail installations or the reconstruction and re-setting to proper line and grade of existing guardrails, as indicated in the contract documents. The guardrails shall consist of steel and/or wood systems of either single face or double face configurations, installed to the dimensions and at locations shown in the contract documents or as directed by the Chief Engineer.

The guardrail systems are designated as follows:

Type I	W-beam (standard-block-out)
Type ID	W-beam (double faced)
Type II	W-beam (weak post)
Type III	Box beam
Type IV	Thrie beam (standard-block-out)
Type IVD	Thrie beam (double faced)
Type V	Corrosion resistant (weathering steel W- beam)
SBT	Steel-backed timber guardrail/timber posts and block-out

- (B) **MATERIALS.** Materials shall meet the following requirements:

W/Thrie Beam Rail Elements, Back-up

Pieces, and Terminal Sections – AASHTO M 180, Class A, Type I

Rail Posts, Offsets, Angles, Channels and Shims – 815.01(A)

Corrosion resistant steel (weathering steel) – 815.01(B)

Tie Rods – 815.01(A)

Splice Bolts, Nuts and Washers – 815.01(L)

Anchor Bolts and Nuts – 815.01(D)

Anchor Rods and Nuts – 815.01(A)

Anchorage Casting Plates – 815.01(I)

Timber posts – 813.07

Timber rails – 813.05

Wood Offset Blocks – 813.05

Composite Offset Blocks – NCHRP 350

Reflectors – 822.13(C)

Turnbuckles – 815.13

PCC – 817, Class F

Epoxy – 822.08

Galvanizing – 811.07

Reinforcing Steel – 812.02

**(C) CONSTRUCTION REQUIREMENTS.**

- (1) **GENERAL.** Prior to erection, all parts shall be inspected for damage and for chipped or marred coatings. Pieces warped, deformed or with damage to galvanizing will be rejected and the Contractor will be required to replace any such damaged parts at his expense. Paint touch-up of marred or chipped galvanizing will not be permitted.
- (2) **POSTS.** Posts shall be driven unless an alternative method is approved by the Chief Engineer. The post driving method shall be such as to avoid battering or distorting the posts. Posts not driven shall be set in holes of sufficient diameter to permit tamping of the backfill. Post holes shall be backfilled with approved material placed in 6 inch layers and thoroughly compacted. When the posts are to be set in existing pavement, all loose material shall be removed and paving material replaced.

If rock is encountered while placing the posts, the hole shall be enlarged to provide not less than 6 inches clearance on all sides, and the hole shall be excavated to a minimum depth of 2.5 feet. The post shall be set in concrete to within 6 inches of the top of the hole. The hole shall be backfilled with approved material, properly placed and compacted.

Any post damaged from driving shall be withdrawn, not used, and another post placed at no additional cost to the District.

Posts may also be driven in existing sidewalk areas where there will be no interference with utilities, catch basins, sewers, etc. In these areas, the existing concrete shall be removed by cutting a square 8 inches by 8 inches to a depth of 1-1/2 inches below the bottom of the sidewalk with a power masonry saw. The remainder of the concrete may be removed by other methods. After the posts are driven, the concrete shall be replaced. Payment for concrete will be made under "PCC for Post Anchorage".

- (3) **ANCHOR BOLT ALTERNATIVE.** Where the existing concrete is of sufficient depth to accommodate the anchor bolts, installation shall be made in predrilled anchor holes.

- (a) **Predrilled Anchor Holes** – Holes shall be drilled to diameters as specified in (c) below. Drilling templates shall be used for all drilling operations to insure properly aligned true anchorage holes. Where dry drilling is employed, the holes shall be vacuumed or blown out using oil-free compressed air. Where the drilling process requires the use of water, holes shall be carefully washed out

after drilling to remove any drilling slurry residue that may remain. Holes shall then be permitted to dry thoroughly before placing bolts.

The Contractor is warned that reinforcing, utilities or other obstructions may be encountered during drilling of anchor holes in concrete. Diamond drilling or other special procedures necessary to construct anchorage shall be included as part of the work. All cost involved in connection with drilled anchorages shall be included as part of work. The Contractor shall assume the entire responsibility for all damage and injury to electrical conduits, utilities and the structure. Repair of any damage shall be included as part of the work.

- (b) Where existing concrete is of insufficient depth to accommodate the anchor bolts, the existing concrete shall be removed to a rectangle approximately 4 inches greater in each dimension than the base plate to be used. The concrete shall be cut to a neat line to a depth of 1-1/2 inches below the concrete surface with a masonry power saw. The rest of the concrete and soils may be removed by other methods.
- (c) Epoxy Installation of Anchor Bolts – Bolts and bolt holes shall be clean, degreased with toulene and dry at the time of installation. Bolts may be installed by either of the following methods:

Holes shall be drilled in existing concrete to diameters not to exceed one quarter (1/4) inch greater than the diameter of the bolts or dowels being embedded or as recommended by the epoxy manufacturer. The bolts and dowels shall be fixed with an epoxy resin adhesive meeting the requirements of 822.08(B)(2).

Holes shall be drilled in existing concrete to diameters at least one (1) inch greater than the diameter of the bolt or dowel being embedded. The bolts and dowels shall be fixed with an epoxy mortar meeting the requirements of 822.08(C).

When using either of the methods specified above, the locations of the holes to be drilled shall be accurately determined by means of templates. The templates shall also be used to hold the bolts in position until the epoxy resin or mortar has cured. The temperature of the concrete where bolts are being installed shall conform to the requirements of 501.10(B) at the time of installation.

- (d) Anchor Dowel Installation – Where bolted anchorages are to be set on PCC mortar blocks, anchor dowels shall be carefully preset by template prior to placing the PCC sidewalk, median or anchor block.
- (e) Base plates shall be set level by the use of steel shims or an epoxy mortar bed to insure plumb posts.

When steel shims are used, they shall be designed to provide full bearing between the full area of base plate and shims and no gaps shall appear between base plates and concrete.

If an epoxy mortar bed is used, it shall be applied to provide a level bed of mortar 1 inch greater in each horizontal direction than the base plate. It shall be a minimum of 1/4 inch thick on the high side and the complete area of the base plate shall be in contact with the mortar bed.

- (4) **ANCHORAGE ON CONCRETE DECKS.** Where installation is to be made on an existing structure and the depth of the deck is less than the required depth for anchor bolts, the installation shall be made as follows:
- (a) Holes shall be drilled through the concrete deck. The Contractor shall prevent broken concrete, other materials and tools from falling onto any traveled roadway, sidewalk or other public space where the safety of the public may be endangered.
  - (b) The base plates, on neoprene pads if required, shall then be anchored to the deck with bolts, anchor plates or any other method as shown on the plans or as directed.

Prior to setting the rails or cables, the posts shall be properly aligned to within a 1/4 inch tolerance of line and grade. Posts shall be plumb.

- (5) **RAIL ELEMENTS.** Rail elements shall be erected to produce a smooth rail paralleling the set line and grade of the highway or as shown on the plans.

All bolts, except expansion joint bolts and adjustment bolts, shall be drawn tight when the rails have been properly aligned and adjusted and approved by the Chief Engineer. Bolts through expansion joints shall be drawn sufficiently tight to prevent the rail elements from slipping over longitudinally. Bolts shall be sufficiently long to extend at least 1/4 inch beyond the nuts. Except when required for adjustment, bolts shall not extend more than 1/2 inch beyond the nuts.

All splices shall be lapped in the direction of traffic. The trailing end of every installation shall be fitted with a rounded type terminal section and lapped on the face of the rail.

All metal shall be fabricated in the shop. Shop-bend all curved guardrail with radii of 150 feet or less. Burning, drilling or welding may be performed in the field when indicated on the plans. Field punching, cutting and drilling may be permitted after the Contractor demonstrates that the process will not damage the metal surrounding the field adjustments, and the process has been approved by the Chief Engineer.

Timber guardrail bolts shall be equally spaced along the front face of the timber rail to match the holes in the steel backing. Steel backing shall have the same vertical dimension as the timber rail. Align timber guardrail along the top and front edges of the rail. Field cut timber rails to produce a close fit at the joints. Field cuts shall be treated with wood preservative as per 811.08.

After final tightening of nuts, projecting threads on all bolts shall be burred to prevent removal.

- (D) **MEASURE AND PAYMENT.** The unit of measure for Guardrail will be the linear foot. The number of linear feet will be the actual length of guardrail measured, complete in place, along face of the guardrail center to center of end posts for each installation.

For double-faced guardrail, measurement will be made along the centerline of posts, center to center of end posts.

Where types of installation change, measurement for each type will begin and/or end mid-way between the posts but will not include terminal sections.

The unit of measure for PCC for Post Anchorage will be the cubic yard, based on field measurement.

Payment will be made at the contract unit price per linear foot, which payment will include all labor, equipment, tools and incidentals) necessary to construct all components of the guardrail system complete in place.

Payment for PCC for Post Anchorage will be made at the contract unit price per cubic yard. Payment will include furnishing and curing PCC, backfilling and all other incidentals.

Payment for anchor bolts or bolt holes will be included in the contract unit price for the appropriate Guardrail pay item.

Payment for additional excavation will be made under the appropriate excavation items.

## 605.02 GUARDRAIL TERMINAL SECTIONS

(A) **DESCRIPTION.** Work consists of the construction of the guardrail terminal sections that are the end components of the guardrail systems. Terminal sections shall be constructed as shown in the DDOT standard drawings or as specified by the manufacturer of a particular type of end treatment. Terminal section construction also includes the proper termination and connection to vertical faces of abutments piers, end walls and safety shaped barriers. Materials, fabrication and construction shall meet the requirements of 605.01(B) and (C)

(1) **GUARDRAIL STANDARD TRAILING TERMINAL** – Work consists of the construction of Guardrail Standard Trailing Terminal at locations as shown on the contract documents or as directed by the Chief Engineer. The unit shall consist of:

6 feet 3 inch section of rail

Standard End Terminal piece

1-1/2 inch diameter galvanized rod, turnbuckle and anchor plate

Miscellaneous hardware

PCC anchor and W6-9 steel anchor post and plate

The anchor blocks shall not be constructed until anchor posts are in the proper place. Stay-in-place forms may be used, or concrete may be placed against plumb, undisturbed earth if approved by the Chief Engineer.

Tie rods shall be positioned prior to concrete placement so that the tie rod is oriented correctly and loosely connected to the anchor at the post. After the anchor block has cured, the tie rod and turnbuckle shall be securely tightened.

The area around the block shall be backfilled and graded with embankment material meeting requirements of 204.

- (2) **GUARDRAIL APPROACH TERMINAL.** Work consists of the construction of Guardrail Approach Terminal sections at locations shown in the contract documents or as directed by the Chief Engineer. Approach Terminal sections shall consist of posts, railing, hardware and the anchorage assembly necessary to construct the type of terminal section specified. Approach Terminal sections shall be installed according to the manufacturer's recommendations.
- (3) **GUARDRAIL EXIT TERMINAL.** Work consists of the construction of Guardrail Exit Terminal sections at locations shown in the contract documents or as directed by the Chief Engineer. Exit Terminal sections shall consist of posts, railing, hardware and the anchorage assembly necessary to construct the type of terminal section specified. Exit Terminal sections shall be installed according to the manufacturer's recommendations.
- (4) **W-BEAM/THRIE BEAM TRANSITION PANEL.** The unit shall consist of one (1) section, as detailed in the contract documents, for connecting W-beam guardrail to thrie beam guardrail, thrie beam impact attenuators or thrie beam guardrail to fixed objects, both approach and exit. Also included is the incidental hardware required for installation.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Guardrail Terminal Sections will be each. The number will be the actual number of each type of Guardrail Terminal Sections installed complete in place and accepted. Payment will be at the contract unit price per each for the respective unit. Payment will include furnishing all components as specified for the particular Guardrail Terminal Sections, to include: all steel components including galvanizing, PCC units, treated timber posts, cable assemblies and anchors. Payment will also include work performed for erection of Guardrail Terminal Sections complete, including excavation, backfilling, disposal of unsuitable materials, shop drawings and all labor, material, tools, equipment and incidentals necessary to complete the work.

### 605.03 RUB RAIL

- (A) **DESCRIPTION.** Work consists of adding a channel section, to be used as a rub rail, on existing or new guardrail installations at the locations as shown on the contract documents or as directed by the Chief Engineer..
- (B) **CONSTRUCTION REQUIREMENTS.** 605.01(C) applies with the following additions:
1. New posts shall be pre-drilled at the fabricator.
  2. Existing posts shall be field drilled.
  3. Edges of field-drilled holes shall be given one coat of zinc primer.
  4. Expansion splices shall be located as shown on the plans, or as directed.
  5. Channels shall be of such a length as to accommodate the post spacing with a 50 foot maximum length.
  6. The Contractor shall make a field inspection of existing guardrail installations so that required channel lengths can be accurately determined.

7. On curves greater than 3 degrees, 15 minutes, the channel shall be fabricated to fit the required curvature.
- (C) **MEASURE AND PAYMENT.** The unit of measure for Rub Rail will be the linear foot, with measurements made along the top of the channel section. Payment shall be the contract unit price per linear foot, which payment will include furnishing, fabricating, galvanizing, field drilling, touch- up painting, installation, tools, labor, equipment and incidentals necessary to complete the work.

#### **605.04 PCC TERMINAL BLOCK**

- (A) **DESCRIPTION.** Work consists of the construction of PCC Terminal Blocks of various dimensions and at locations as shown in the contract documents, or as directed by the Chief Engineer. Work shall include excavation, forming, reinforcing steel, PCC, labor, tools and equipment necessary to complete the item.
- (B) **CONSTRUCTION REQUIREMENTS.** The Contractor shall perform the necessary excavation to construct the PCC Terminal Block. Whenever possible, the excavation shall be done in undisturbed earth. Unsuitable excavated materials shall be disposed of by the Contractor. PCC work shall be done in conformance with applicable provisions of 501. After the PCC has cured, the area around the PCC Terminal shall be backfilled with embankment fill meeting the requirements of 204. Anchor bolts may be inserted in the plastic concrete or in expansion shields that may be installed in pre-drilled holes. The anchors shall be included as part of Guardrail Items.
- (C) **MEASURE AND PAYMENT.** The unit of measure for PCC Terminal Block will be the cubic yard, with measurement based on the plan dimensions. Payment will be made at the contract price per cubic yard, which payment will include excavation, backfill, disposal of excess and unsuitable excavated materials, forming, PCC, reinforcing steel, tools, labor, equipment and incidentals necessary to complete the work.

#### **605.05 REMOVE GUARDRAIL BURIED TERMINAL**

- (A) **DESCRIPTION.** All existing buried terminal sections shall be removed and replaced with modified eccentric loader terminal sections or various impact attenuator devices. Work consists of the complete removal of buried terminal sections including single and double rail, the PCC anchor block, anchorage shoe or shoes, 25 feet of twisted guardrail(s) plus the runout rail(s), and intervening posts, brackets and hardware. Work also includes necessary excavation and backfilling of holes from which anchor block and posts are removed and the disposal of all unusable guardrail elements including anchor blocks. Usable elements, if any, shall be saved for reuse.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Remove Guardrail Buried Terminal will be each. The number will be the actual number of buried terminals, single or double rail, completely removed. Payment for Remove Guardrail Buried Terminal will be made at the contract unit price per each, which payment will include complete removal of the buried terminal sections, including excavation and backfilling, disposal of all unsuitable elements, and all labor, materials tools, equipment and incidentals necessary to complete the work.

**605.06 REMOVE GUARDRAIL**

- (A) **DESCRIPTION.** Work consists of removing, dismantling, cleaning, touch-up painting, and storing of existing guardrail.

All guardrail elements shall be carefully removed from the posts and be carefully examined. Those elements meeting the Chief Engineer's approval shall be stockpiled in an area acceptable to the Chief Engineer. All rails and posts shall be cleaned and any marred or chipped areas in the galvanizing shall be painted with a zinc-rich paint. Elements determined by the Chief Engineer to be unsuitable shall be disposed of properly.

All post holes shall be backfilled with applicable material and compacted. Anchor bolts in existing PCC shall be removed by burning off flush with the PCC, and the area shall be painted with zinc-rich paint.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Remove Guardrail will be the linear foot of guardrail removed with measurement made along the front face of the guardrail or along the posts for double-faced guardrail. Payment will be made at the contract unit price per linear foot, which payment will include removal, dismantling, cleaning, touch-up painting, stockpiling, disposal of unusable elements, backfill and compaction of post holes, and all labor, tools, equipment and incidentals necessary to complete the work.

**605.07 RESET GUARDRAIL**

- (A) **DESCRIPTION.** Work consists of resetting usable guardrail, removed and stored as per 605.06

Sections 605.01(B) and 605.01(C) apply.

- (B) **CONSTRUCTION REQUIREMENTS.** Section 605.01(B) applies with the following additions:

Any materials damaged or missing prior to, during or subsequent to removal due to the Contractor's negligence, shall be replaced at the Contractor's expense. Additional posts, offsets, back-up pieces, plate washers, bolts, nuts, reflectors and other necessary equipment needed to provide 6 feet 3 inches post spacing will be included as part of this item.

Additional rail-post bolt holes shall be drilled after the rail is reset. Edges of field-drilled holes shall be given 1 coat of zinc-rich paint.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Reset Guardrail will be the linear foot of guardrail reset, with measurement made along the front face of the guardrail. Payment will be made at the contract unit price per linear foot, which payment will include furnishing all additional required materials, shop drawings, galvanizing, field drilling, touch-up painting, and all labor, tools, equipment and incidentals necessary to complete the work.

**605.08 EXTRA GUARDRAIL COMPONENTS**

- (A) **DESCRIPTION.** Work consists of furnishing and installing guardrail components that are in addition to the standard guardrail configuration. Transitions to rigid barriers as well as backup plates, posts, rails, offsets and other materials used to stiffen sections as directed by the contract plans will be paid for under this item.
- (B) **MATERIALS.** Requirements of 605.01(B) apply.
- (C) **METHODS OF CONSTRUCTION.** Requirements of 605.01(C) apply.
- (D) **MEASURE.** The unit of measure for Extra Guardrail Components will be the pound. The weight shall be for the finished galvanized components with galvanizing and allowable overrun percentage in accordance with AASHTO M 111 and AASHTO M 160 respectively. No deduction will be made for bolt holes. No measure will be made for weight of weld metal or for spike bolts and nuts.
- Weights of the hardware components will be computed from the weight determined by the Chief Engineer or from weights furnished by the manufacturer and approved by the Chief Engineer.
- (E) **PAYMENT.** Payment for Extra Guardrail Components will be made at the contract unit price per pound, which payment will include furnishing and installing galvanized and reflectorized hardware, galvanizing, furnishing, storage, transportation, erection, drilling of bolt holes and all labor, materials, tools, equipment and incidentals needed to complete the work specified.

## **606 PAVEMENT PROFILING (MILLING)**

### **606.01 DESCRIPTION**

Work consists of profiling the existing asphaltic or PCC roadways to the depth specified in the contract documents or as directed by the Chief Engineer.

Unless otherwise specified, all millings removed become the property of the Contractor and this material shall be removed and disposed of away from the site.

### **606.02 EQUIPMENT AND CONSTRUCTION**

Equipment to be used for the milling process shall be inspected and approved prior to use and must pass all air quality regulations of the District. The milling machine must have the capability of milling a path a minimum of 40 inches wide and must have baffles attached to direct the milled material to the center point of the machine. It is desirable that the machine be equipped with a truck loading conveyor. If the areas adjacent to utility structures, corners, gutters, and all similar roadway projections are inaccessible to the milling machine, the Contractor shall place these areas on grade by other methods approved by the Chief Engineer. The total completed process shall leave a finished surface which does not vary more than 1/4 inch from a 10 foot straightedge.

### **606.03 MEASURE AND PAYMENT**

The unit of measure for Pavement Profiling will be the square yard for each specified depth with no deductions for structures in the roadway. The number of square yards will be paid for at the contract unit price appropriate for the milling depth, which payment will include the cost of furnishing all labor and equipment, including cutting to a neat line, jack hammering, hand milling and the hauling and disposal of all milled material. Feathering of asphalt around manholes and other appurtenances, ramping, filling of voids and other measures necessary to assure a safe riding condition shall be included in Pavement Profiling and no additional payment for these measures will be made.

**607 MISCELLANEOUS FENCING****607.01 CHAIN LINK FENCE**

- (A) **DESCRIPTION.** Work consists of furnishing, fabricating, assembling, and erecting chain link fencing along property line and/or adjacent to a roadway. The fence shall be erected to the lines, grades, and height as shown in the contract documents or as directed by the Chief Engineer. Unless otherwise provided a top rail shall be used for a property fence and tension wire shall be used for the top of a fence adjacent to a roadway.

Work shall include clearing the fence line and disposing of resulting brush and debris, removal of high points in the existing ground between posts; connecting fences to other structures or existing fences, and other incidental work necessary to complete the specified work.

**(B) MATERIALS.**

Portland Cement Concrete Class F (for post footings) – 801.01 and 817

Barbed Wire – 813.01

Chain Link Fence Fabric – 813.03(A) (1)

Chain Link Fence Components – 813.03(A) (2) and 813.03(A) (3)

Gates – 813.03(A) (4)

Wood for Redwood Slats – 822.12

The height and type of fence shall be as specified in the contract documents. When the type of chain link fence is not specified, one of the following types shall be used, meeting the requirements of 813.03 and AASHTO M 181 and shall include all chain link fence materials, including fence fabric, posts, rails, ties, bands, bars, rods, hardware and other fittings.

Type I: Zinc-coated steel; fabric, posts, hardware, and fittings.

Type II: Aluminum-coated steel: fabric and zinc coated posts, hardware, and fittings.

Type III: Aluminum-alloy: fabric, posts, hardware, and fittings.

Type IV: Polyvinyl Chloride (PVC)-coated: fabric.

Type I shall be used unless otherwise specified.

Chain link fence fabric shall be made of No. 9 gauge wire, woven in a 2 x 2 inch diamond mesh.

All pipe components shall be standard weight pipe of the following nominal diameters:

Intermediate or line posts – 2 inches End, corner and pull posts – 2-1/2 inches Top rails and post braces – 1 ¼ inches Tension bars and wires – No. 7 gauge

Posts for swing gates shall be standard weight steel pipe of for single swing gates or one leaf of double gates and of the size indicated in the DDOT Standard Drawings or in the

contract documents. Gates shall be complete with hinges, latches, stops and other necessary fittings.

Barbed wire, when specified, shall be of the 4-point pattern, composed of 2 strands of No.12-1/2 gauge line wires with No.14 gauge barbs spaced on approximately 5 inch centers. Barbed wire shall conform to the requirements of AASHTO M 280.

**(C) CONSTRUCTION REQUIREMENTS.** Installation shall be by skilled mechanics experienced in the erection of this type of fence. Details not specified herein shall meet the requirements of the standard drawings and the contract documents. Construction shall be as follows:

1. The Contractor's activities and operations shall be confined to the area immediately adjacent to the right-of-way lines and within the right-of-way except that permission may be granted by the Chief Engineer for normal construction activities through lands owned by or under the control of the District.

In areas where any privately owned fence or other property is within the District's right-of-way, these items shall be removed by the property owner in advance of the District's Contractor commencing work; however, in the event that the property owner has not removed these items, the Contractor shall remove these items and place them on the owner's property as directed by the Chief Engineer. The Contractor shall be held responsible for any damage to privately owned items removed.

Fence lines specified in the contract documents serve as a guide only, and the exact location of the fence shall be determined in the field, as directed by the Chief Engineer.

2. The posts shall be set plumb in concrete footings as shown on the plans, spaced not more than 8 feet on centers. The minimum cross-section dimension of the footings shall not be less than 3 times the maximum cross-sectional dimension of the post, but in no case less than 9 inches for line posts and no less than 12 inches for end or corner posts.
3. The top rails shall be provided with expansion shield couplings or other suitable devices approximately every 20 feet. The couplings are to be outside sleeve type at least 7 inches long. Expansion spring couplings are to be installed at 100 foot intervals on sections over 100 feet long. The top rail shall pass through the base of the line post tops and form a continuous brace from end to end, and shall be securely fastened to the end and/or corner posts with heavy pressed steel connections.
4. The wire fabric shall be fastened to the end and/or corner posts using a tension bar fastened to the posts with pressed steel bands. The bands are to be connected with carriage bolts and nuts. The fabric is to be stretched to proper tension and fastened to all line posts with wire clips and to the top rail with tie wires. The wire fabric is to be attached to a bottom tension wire with hog rings. The bottom of the fabric is to be held as uniformly as is practical to 2 inches above the finished grade.
5. Any excavation or backfill required to comply with the above clearance shall be as approved by the Chief Engineer. Fence fabric shall be placed on the roadside of the

posts. For storm water management ponds, the fabric shall be placed on the outside of the posts or the side farthest from the pond.

6. The fence shall be taut and true.
7. All end and/or corner posts shall be braced by a horizontal post brace. The post brace shall be securely attached to the end or corner post, to the posts adjacent to expansion couplings, and to the next adjacent line post midway between the top rail and the ground. This brace shall be truss-braced from the line post to the end or corner post with a truss rod complete with tightening unit. Corner posts and line posts, at intervals of 500 feet, shall be trussed and braced in both directions.
8. All posts shall be plumbed and spaced as uniformly as practicable to the spacing specified in the standard drawings or the contract documents with a tolerance of 2 feet.

End or corner posts shall be installed at all terminals, abrupt changes in grade and at changes in horizontal alignment greater than 15 degrees. The maximum distance between end or corner posts shall be 500 feet.

Post lengths shall accommodate the fabricated width of the fence fabric without stretching or compressing the fabric and provide the required spacing below the bottom of the fabric.

Post caps are required at all line, end and corner posts.

9. Gate frames shall be constructed of standard weight pipe with heavy malleable iron or pressed steel corner fittings securely riveted. Fabric to match the fence shall be installed in the frame by means of tension bars and hook bolts. Each frame shall be equipped with adjustable truss rods. Bottom hinges shall be ball and socket type designed to carry the weight of the gate on the post footing. Upper hinge shall be wraparound adjustable type. All gates shall be equipped with a positive type latching device with provisions for padlocking. All drive gates shall be provided with center plunger rod, catch, and semiautomatic outer catches to secure gates in opened position.
10. All posts shall be equipped with malleable, cast iron or pressed steel ornamental tops or extension arms for barbed wire as shown in the standard drawings or in the contract documents. Tubular post tops are to be so designed as to exclude moisture from the post. All intermediate post tops shall be designed to hold the top rails.
11. When barbed wire is specified, it shall be stretched to proper tension and securely fastened to the framework members by the use of heavy wire pins.
12. Where fencing crosses a drainage ditch, a line post shall be set on each side of the ditch so that the bottom of the fence is low enough to preclude the possibility of anyone climbing underneath. No post shall be set in a drainage ditch unless indicated in the contract documents. Posts shall be fitted with tops as shown on the plans, or other approved tops so designed as to fit securely over the posts and carry the top tension cable.
13. When the fence crosses electrical transmission, distribution or secondary lines, a ground shall be installed at each crossing, in accordance with Section 9 of the National Electrical Code.

- (D) **MEASURE AND PAYMENT.** The unit of measure will be the linear foot. The number of linear feet will be the actual length of Chain Link Fence, complete in place, measured horizontally along the fence from center to center of end posts. Gates will be measured on the basis of the count or number of each type or size installed complete.

Payment will be made at the contract unit price per linear foot, which payment will include the fabricating and furnishing of all materials, including barbed wire if used, labor, tools, equipment, and incidentals necessary to complete the work.

Gates will be paid for at the contract unit price per each type or size as counted, which payment will include the fabricating and furnishing of all materials, including barbed wire if used, labor, tools, equipment, and incidentals necessary to install the gate or gates complete in place.

#### **607.02 VINYL CLAD CHAIN LINK FENCE WITH REDWOOD SLATS**

- (A) **DESCRIPTION.** Work consists of the fabricating, furnishing, assembling, and erecting Vinyl Clad Chain Link Fence with Redwood Slats. The Vinyl Clad Chain Link Fence with Redwood Slats shall be constructed to the lines and grades shown in the contract documents.
- (B) **MATERIALS.** All materials shall meet the requirements of 607.01(B) unless otherwise specified on the standard drawings and/or in the contract documents.
- (C) **CONSTRUCTION REQUIREMENTS.** Installation shall be by skilled mechanics experienced in the erection of this type fence. Details shall meet the requirements of the standard drawings and/or the contract documents.
- (D) **MEASURE AND PAYMENT.** The unit of measure will be the linear foot. The number of linear feet will be the actual length of Vinyl Clad Chain Link Fence with Redwood Slats, complete in place, measured horizontally along the fence from center to center of end posts. Gates will be measured on the basis of the count or number of each type or size installed complete.

Payment will be made at the contract unit price per linear foot, which payment will include the fabricating and furnishing of all materials, labor, tools, equipment, and incidentals necessary to complete the work.

#### **607.03 SAFETY FENCE SHIELDING**

- (A) **DESCRIPTION.** Work consists of the fabricating, furnishing, assembling, and erecting safety fence shielding on bridges and overpasses. The shield shall be constructed to the lines and grades and height shown in the contract documents.
- (B) **MATERIALS.** All materials shall meet the requirements of 607.01(B), except as modified herein.

All posts shall be standard weight pipes, 2-1/2 inches I.D.

Top rails and post braces shall be standard weight pipe, 1-1/4 inches I.D.

Plates shall meet the requirements of ASTM A 36.

Anchor bolts shall meet the requirements of ASTM A 307, Grade A.

(C) **CONSTRUCTION REQUIREMENTS.** Installation shall be by skilled mechanics experienced in the erection of this type fence. Details not specified herein shall meet the requirements of the standard drawings and/or the contract documents. Construction shall be as follows:

1. The Contractor's activities and operations shall be confined to the area immediately adjacent to the right-of-way lines and within the right-of-way except that permission may be granted by the Chief Engineer for normal construction activities through lands owned by or under the control of the District.

Fence lines specified in the contract documents serve as a guide only and the exact location of the fence shall be determined in the field as directed by the Chief Engineer.

2. The posts shall be set plumb and as shown in the contract documents.
3. The top rails shall be provided with expansion couplings at each expansion joint in the structure.

The couplings are to be inside sleeve type at least 7 inches long and suitably welded to the rail. Expansion couplings shall be galvanized after welding.

4. The wire fabric shall be fastened to the end and/or corner posts using tension bar fastened to the posts with pressed steel bands. The bands are to be connected with carriage bolts and nuts. The fabric is to be stretched to proper tension and fastened to all line posts with wire clips and to the top rail with tie wires. The wire fabric is to be attached to a bottom tension wire with hog rings. The bottom of the fabric is to be held as uniformly as is practical to 2 inches above the finished grade.
5. All end and/or corner posts shall be braced by a horizontal brace. The post brace shall be securely attached to the end or corner post, to the posts adjacent to expansion couplings, and to the next adjacent line post midway between the top rail and the ground. This brace shall be truss-braced from the line post to the end or corner post with a truss rod complete with tightening unit. Corner posts and line posts, at intervals of 500 feet, shall be trussed and braced in both directions.
6. The fence shall be taut and true.
7. All posts shall be plumbed and spaced as uniformly as practicable to the spacing specified in the standard drawings and/or in the contract documents with a tolerance of 2 feet.

Post lengths shall accommodate the fabricated width of the fence fabric without stretching or compressing the fabric.

Post caps are required for all line, end and corner posts.

8. Welding shall conform to the requirements of 706.18.

(C) **MEASURE AND PAYMENT.** The unit of measure for Safety Fence Shielding will be the linear foot. The actual length of Safety Fence Shielding measured horizontally along the fence from center to center of end posts, will be paid for at the contract unit price per

linear foot, which payment will include the fabricating and furnishing of all materials, labor, tools, equipment and incidentals necessary to complete the work.

#### **607.04 CONSTRUCTION BOARD FENCE (SOLID WOOD FENCE)**

- (A) **DESCRIPTION.** Work includes furnishing, installing, maintaining, relocating and removing 8-foot high board fencing around the construction area as shown on the contract plans and as directed by the Chief Engineer. The board fence shall be painted (all sides) with a neutral shade of green color paint approved by the Chief Engineer. Maintenance will include, but not limited to, any repainting or repairing as directed for the duration of the contract.

The fence shall be constructed with 1 x 6 inch boards and with 2 x 4 inch top and bottom horizontal brace members, and supported by 4 x 4 inch posts at a maximum spacing of 8 feet apart. Posts shall be set in augered holes or driven a minimum depth of 2 feet into the ground. Each post shall be braced by a 2 x 4 inch brace member meeting each post at a 45 degree angle and placed in the ground to a depth of approximately 2 feet. Lumber shall be Grade No. 2 common square cut. The Chief Engineer shall approve the materials before and after installation.

Each tree not scheduled for removal but which may be damaged by construction activity on this project shall, upon the direction of the Chief Engineer, be protected by tree boxes of a minimum size of 6 feet square and 8 feet high. Trees enclosed by the work area board fence may be protected as directed. Hand excavation shall be used beneath the low branches of trees where the use of mechanical equipment might be injurious to tree limbs.

- (B) **MEASURE AND PAYMENT.** The unit of measure will be the linear foot of fence installed, and measured along the top edge of the fence including gates and tree boxes as needed.

Payment for Construction Board Fence will include gates and tree boxes as needed and be made at the contract unit price per linear foot installed, which payment will include all materials, erection, hardware, locks and keys, tree boxes, painting, repainting, maintenance, repair and removal, and all labor, tools, equipment and incidentals needed to complete specified work.

#### **607.05 TEMPORARY FENCE**

- (A) **DESCRIPTION.** Work consists of of the installation of temporary fence for work zone pedestrian and site protection. The Contractor shall be required to protect the work area as shown on the contract plans or as directed by the Chief Engineer. The Contractor shall furnish all materials Work under this item includes furnishing, installing, relocating (if necessary), removal and disposal of the fence.
- (B) **MATERIALS.** Fencing shall be of a type used for temporary protection and shall have a minimum height of 3 feet 6 inches. Posts shall be steel "U" channel posts, 3 pounds per foot, and either galvanized or painted.
- (C) **CONSTRUCTION METHODS.** Installation of the fence shall be performed prior to commencement of construction, or at a time required by the Chief Engineer.

Where indicated in the contract documents, erosion and sediment control measures shall be installed as approved by the Chief Engineer. Removal and disposal of the fence shall be done at a time during and/or after restoration of property, as required by the Chief Engineer.

- (D) **MEASURE.** The unit of measure for Temporary Fence will be the linear foot. The number will be the actual number of linear feet of fence installed complete, as measured along the base of the fencing.
- (E) **PAYMENT.** Payment for Temporary Fence will be made at the contract unit price per linear foot, which payment will include furnishing all materials such as fencing, posts, hardware and straw bales, installing, relocating if necessary, and removal and disposal and all labor, materials, tools, equipment and incidentals needed to complete work specified herein.

#### **607.06 ORNAMENTAL SAFETY FENCE**

- (A) **DESCRIPTION.** Work consists of the fabrication, furnishing, assembling, and erection of ornamental safety fence on bridges and overpasses. The ornamental fence shall be constructed to the lines and grades and height as shown in the contract drawings.

- (B) **MATERIALS.**

Plates shall meet the requirements of AASHTO M183.

Anchor bolts shall meet the requirements of ASTM A 307, Grade A.

For post heights up to 60 inches

For post heights over 60 inches and less than 96 inches

For post heights greater than 96 inches

The fence shall be designed to be free standing and to withstand all applicable wind, pedestrian and bicycle loadings. If required in the contract documents, appropriate railings shall be designed and attached to the fence as per the most current ADA and bicycle requirements. Prior to fabrication, the Contractor shall submit for approval shop drawings, calculations and material samples to the Chief Engineer.

The fence panels shall be electro-forged steel fencing consisting of 31/32 inch x 1/8 inch main bar, 3/16 inch round cross bar and 2-7/16 inches x 5-3/16 inches mesh. Fence shall be galvanized as per ASTM 123 and/or powder polyester coated. The color shall be matte bronze.

- (C) **CONSTRUCTION REQUIREMENTS.**

Installation shall be by skilled mechanics experienced in the erection of this type of fence. Construction shall be as follows:

1. Posts shall be set plumb and as shown in the contract documents. For post heights up to 60 inches, the post size shall be 2-1/2 inches x 5/16 inch flat bar; for post heights greater than 60 inches and less than 96 inches, the post size shall be 3-1/2 inches x 5/16 inch flat bar; and for post heights greater than 96 inches, the post shall be 2 inch square tube.

2. The rails shall be 2 ½ inches x 2 ½ inches x 3/16 inch. The base plates shall be 8 inches x 8 inches x 3/8 inch. The top rails shall be provided with expansion couplings at each expansion joint in the structure.
  3. Welding shall be as per Section 706.18.
- (D) **MEASURE AND PAYMENT.** The unit of measure for Ornamental Safety Fence will be the linear foot. The actual length of fence measured horizontally along the fence from center to center of end posts will be paid for at the contract unit price per linear foot, which payment will include the fabrication and furnishing of all materials, tools, equipment and incidentals necessary to complete the work.

**608 SIDEWALK AND DRIVEWAY****608.01 PORTLAND CEMENT CONCRETE SIDEWALK AND DRIVEWAY**

- (A) **DESCRIPTION.** Portland cement concrete sidewalk and driveway shall be composed of Portland cement concrete proportioned, mixed, and constructed on the prepared soils base in accordance with these specifications, in one course, to a depth specified in the contract documents. Except as herein stated, all requirements specified in 501 are applicable to this specification.
- (B) **COMPOSITION.** The proportions of materials for concrete shall meet the requirements of 817 for Class F PCC.

The concrete for sidewalks shall be darkened by incorporating in the mix at the batch plant, a carbon powder, meeting requirements of 814.06(A), at the rate of 1/3 of a pound per sack of cement.

It may be necessary to vary the above amounts of carbon powder to match existing portland cement concrete. Under no circumstances however, shall the quantities be increased such that the resulting reduction in strength exceeds 5 percent when tested in accordance with AASHTO T 106.

Care shall be taken to see that the portland cement concrete is uniformly darkened and if necessary, additional mixing may be required.

(C) **CONSTRUCTION REQUIREMENTS.**

- (1) **PLACING CONCRETE.** Concrete sidewalk and driveway shall be placed on a base course constructed as specified in Table 203.03. The concrete shall be placed for the full width of the sidewalk and driveway. It shall be thoroughly spaded along the edges and shall be tamped to eliminate voids and bring sufficient mortar to the top of the forms by use of metal shod templates.

When a concrete sidewalk abuts other structures, the area of the structure against which the sidewalk concrete is placed shall be given a heavy coating of bituminous material meeting the requirements of 802.03 or 802.04. When a sidewalk is constructed between an adjoining permanent structure on one side and a curbing, either stone or concrete on the other, one-half inch thick expansion joint material having a recovery of 90 percent or more shall be installed adjacent to the curbing. When a concrete driveway abuts a concrete pavement and/or sidewalk the same type of expansion material shall be installed. No separate payment will be made for expansion joint material. It will be included in the payment of the appropriate PCC item.

Every effort shall be made to safeguard trees. If it becomes necessary to trim tree roots, the Contractor must notify the Chief Engineer prior to trimming. The Contractor will then carry out his trimming operation under the supervision of the District's Urban Forestry Administration.

The nature and extent of tree root removal in connection with sidewalk construction will be determined prior to work scheduling. Minor root removal and the forming

and construction of tree boxes around existing and/or proposed tree locations shall be included in the contract price for PCC Sidewalk.

- (2) **PLACING REINFORCEMENT.** Wire fabric reinforcement will not be required in portland cement concrete sidewalk. However, wire fabric reinforcement of not smaller than No. 20 wire, spaced at one inch, shall be placed around manhole frames and other types of structures extending through the full depth of the sidewalk. The material shall be cut approximately 6 feet square with a hole of the proper diameter cut in the center. The reinforcement shall be placed one inch below the surface of the sidewalk. Wire fabric reinforcement weighing 50 pounds per 100 square feet shall be placed in driveways.

(3) **FORMING JOINTS.**

(a) **TRANSVERSE JOINTS.**

- (1.) **Transverse Expansion Joints** – Transverse expansion joints shall be installed at intervals of approximately 48 feet and shall be provided with a means for load transfer. The expansion joint filler shall be of the preformed type, 1/2 inch in thickness and conform to the requirements of 807.01(A). The filler for this work shall have a recovery of not less than 90 percent and shall be installed flush with the finished surface of the sidewalk.

Where sidewalks intersect, transverse expansion joints shall be placed in each sidewalk for its full width near the intersections of the back lines of the sidewalks or as directed by the Chief Engineer. Where cement concrete leads abut the curb, expansion joint filler must be placed at the back of the curb.

- (2.) **Transverse Contraction Joints** – Transverse contraction joints shall be constructed as weakened place joints at approximately 12 foot intervals as described in paragraph (6) below.

(b) **LONGITUDINAL JOINTS.** Longitudinal joints will not be required in this work.

- (4) **LOAD TRANSFER ASSEMBLY.** Transverse expansion joints shall be provided with means for transfer of load across the joint by use of dowels or other approved methods. The assembly shall meet the requirements of 807.03 except that the assembly shall be fabricated from 3/8 inch rods, the dowel bars shall be 1/2 inch in diameter and shall be spaced at approximately 2 foot intervals but not closer than one foot to the edge of the sidewalk.

The assembly shall be installed in a manner conforming to the requirements of 501.14(E).

- (5) **SEALING OF JOINTS.** Joints with pre-formed joint filler shall be sealed with a sealant conforming to 807.02(A) (1). The preformed filler shall be removed to 1/2 inch below the top of sidewalk and this space sealed.
- (6) **FINISHING.** After the surface has been struck off and screeded to the proper elevation, it shall be given a smooth finish, free from depressions or irregularities of any kind. In no case shall dry cement or a mixture of dry cement and sand be

sprinkled on the surface to absorb moisture or hasten hardening. The surface shall be marked into 3 foot squares, or as directed, by forming longitudinal and transverse grooves  $\frac{1}{2}$  inch in depth with a jointing tool having a blade projection of  $\frac{1}{2}$  inch and blade radius of  $\frac{3}{8}$  inch. At intervals of 12 feet, or as directed, the transverse groove shall be made  $\frac{1}{3}$  the depth of the sidewalk to form a transverse contraction joint. When this groove is formed with a jointing tool, the blade projection shall be not less than  $\frac{1}{3}$  the depth of the sidewalk; if a bar or plate is used, it shall be tapered from top to bottom so that it may be easily removed without damage to the sidewalk.

After final finishing, the sidewalk surface shall be lightly broomed with a hair broom meeting the requirements of 905.09(D) (2).

- (D) **TREE SPACES.** That area, either continuous or interrupted, between the curb and the sidewalk shall be defined as a tree space. The edges of the sidewalk around these spaces shall present clear, vertical faces true to line. The spaces shall be filled to the level of the sidewalk with topsoil meeting the requirements of 823.01. Payment for the topsoil will be made under a separate item. The minimum size of the tree space shall be 4 feet wide, measured from the front face of the curb, by 9 feet long unless otherwise directed by the Chief Engineer.
- (E) **EXPOSED AGGREGATE SIDEWALK.** The exposed aggregate sidewalk shall be constructed in one course to the thickness specified. Carbon powder will not be used in the PCC slab unless otherwise specified. Reinforcement or load transfer devices will not be required unless otherwise specified.

Coarse aggregate for concrete slab mix shall be the same as that used for the seeding. Select aggregate for exposed aggregate seeding shall be washed No. 67 rounded (not crushed) gravel free from deleterious materials such as iron oxides and iron pyrites. The aggregate shall be washed dust-free in a wheel barrow or other suitable container. Select aggregate samples shall be submitted to the Chief Engineer for approval. Aggregate source, cement type, and cement brand shall not be altered during the course of the work.

Exposed aggregate sidewalk construction shall be in accordance with the following:

1. The Contractor will construct a 4 foot by 4 foot horizontal sample test panel using the same material and methods that he intends to use in this construction. Work shall not proceed until the sample has been approved by the Chief Engineer. The approved sample panel shall be kept at the job site until the work is finished. Extreme care must be maintained by the Contractor to properly arrange his work and to employ only masons skilled in this class of work in order that the finished surface shall conform to the approved sample.
2. The PCC slab shall be constructed on the prepared soils base. Immediately after the slab has been placed, screeded, floated, or darbied, the unsegregated seeding aggregate shall be hand-scattered over the slab so that approximately 50 of the  $\frac{1}{2}$  inch to 1 inch stones occupy each square foot (smaller stones scattered are not counted). The seed aggregate shall be in a damp condition when placed on the surface of the slab. The aggregate shall be embedded initially by tapping with a wood float, a straight edge or a darby, and finally by using a bull float, or hand float until the appearance of the surface is similar to that of a normal slab after floating.

Care shall be taken not to overdo floating so as not to depress the aggregate too deeply.

3. Approximately 30 minutes after final troweling, the surface shall be uniformly sprayed with an approved retarder, covered with a plastic sheet and let set for 10 to 20 hours.
  4. Ten to 20 hours after the application of the retarder, scrub out cement with a coarse water spray and a fiber brush until the larger stones are well exposed. Care must be taken not to dislodge the aggregate as patching will not be permitted. The use of a steel brush will be permitted only in spots where surface shows excessive sand. When the brushing is completed the entire surface shall be carefully swept clean with fiber brushes to remove the excess mortar, which shall be removed from the site of the work.
  5. The surface shall be covered and cured for seven days in accordance with 501.17.
  6. After curing, the surface shall be scrubbed with a 10 percent solution of muriatic acid and water. The entire surface shall then be washed thoroughly with water.
- (F) COMPLETION OF WORK.** Before acceptance, the work shall be cleaned up and all debris and unused material removed. Any defective sections shall be replaced or repaired immediately by the Contractor at his own expense. All work hereunder must be completed within 1 week after the construction of the sidewalk is completed.

**(G) MEASURE AND PAYMENT.**

- (1) The unit of measure for Portland Cement Concrete Sidewalk, Exposed Aggregate Sidewalk and Exposed Aggregate Sidewalk Repair will be the square yard. The actual number of accepted square yards, 4 inches in depth, complete in place, measured along the sidewalk surface will be paid for at the appropriate contract unit price per square yard, which payment will be full compensation for furnishing, hauling, and placing all materials, including joints, load transfer devices, expansion joint materials, and reinforcement, for the removal and disposal of all existing sidewalk and curing; and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.
- (2) The unit of measure for Portland Cement Concrete Driveway will be the square yard. The actual number of square yards, of the depth specified, measured complete in place will be paid for at the contract unit price per square yard, which payment will be full compensation for furnishing, hauling, and placing all materials including expansion joint filler, waterproofing, impervious materials, wire fabric reinforcement, curing, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

**608.02 PORTLAND CEMENT CONCRETE SIDEWALK REPAIR AND**

**MISCELLANEOUS CONSTRUCTION**

- (A) DESCRIPTION.** Repairs to PCC sidewalk and miscellaneous construction shall consist of the cutting out, removal and disposal of the old material from defective areas and replacing with portland cement concrete to a depth equal to that of the surrounding

concrete, or as directed by the Chief Engineer. Materials and methods meeting, insofar as practicable, the requirements specified for new construction of similar type shall be used.

This work shall include also the replacing, in a manner described above, of cuts or openings for underground work.

- (B) **MATERIALS.** The materials shall meet the requirements of 501.02.
- (C) **COMPOSITION.** The proportions of materials for concrete shall meet the requirements of 817.03 for Class F PCC.
- (D) **CONSISTENCY.** The consistency of the concrete shall be as specified in 501.15.
- (E) **CONSTRUCTION REQUIREMENTS.** Portland cement concrete repair shall conform to the requirements of these specifications for new construction of a type similar to that on which the repairs are to be made, with the following exceptions, changes, or additions:
  - (1) **PREPARATION FOR CONCRETE REPAIRS.** The defective areas to be repaired shall be prepared by removing all defective materials as directed by the Chief Engineer. This area shall be graded to depth necessary to construct the repair so that it will meet the requirements of these specifications for new construction. If unsuitable material is discovered in the soils base, it shall be removed and replaced with material conforming to 804.04 and measured and paid for as per 209.07.

The concrete adjoining the section to be replaced shall be left with straight edges. Sidewalk replacement shall be extended to the scored joint and/or the existing repair as directed by the Chief Engineer.

All costs of cutting back, removal, and disposal of the excavated material to the depth of pavement which is to be placed shall be included in the contract unit price for Repair of Portland Cement Concrete Pavement Sidewalk or Miscellaneous Repair. Material to be removed above or below the pavement will be paid for at the contract unit price under 202.

- (2) **PLACING CONCRETE.** The edges of the concrete adjoining the repair shall be thoroughly cleaned and wetted just prior to depositing fresh concrete against them. Any damaged expansion joint material in the area to be repaired shall be replaced with new material and shall conform in all respects as to type, quality, and method of installation to that of new construction. Sufficient carbon powder shall be used in the repair of sidewalk so that the repaired area will closely match the color of the existing concrete. The cost of furnishing carbon powder for sidewalk repair will be included in the contract unit price per square yard for concrete sidewalk repair.

If sufficient concrete is not available to completely fill the repair section, bulkhead timber of the depth of the repair shall be placed to receive the concrete.

When truck-mixed concrete is used for repair, re-tempering the concrete and placing of concrete which has attained initial set will not be permitted. The interval between the admission of cement to the batch and final discharge shall not exceed 2 hours.

It is important that all locations at which concrete is to be used are fully prepared prior to delivery of the concrete and that only sufficient concrete is ordered to permit its use within the time limit specified for hauling concrete. Due to the difficulty of placing concrete in irregular and small repairs and the importance of

attaining the best possible results, the Contractor shall proceed with the utmost diligence in the prosecution of all phases of work.

- (3) **CURING.** When wet burlap is used for curing, special care should be used to be sure it is thoroughly wet, that it is placed over the concrete surface as soon as the finishing is complete, and that the burlap is kept wet in conformance with these specifications. Where it is not practicable to keep burlap, placed on concrete for curing, continually wet overnight following the placing of the concrete, a membrane cure meeting the requirements of 814.03 shall be applied to the surface as directed by the Chief Engineer. Membrane cure shall not be used during the period classified as Cold Weather Construction.
- (4) **PROTECTION.** All classes of traffic shall be excluded from pavements by the erection and maintenance of suitable barricades for a period of 24 hours after placing the concrete. This curing period will be increased to 48 hours in the case of roadway and alley construction during the period classified as Cold Weather Construction.

The Contractor shall be responsible for the cuts and their condition from the initiation of excavation to the removal, upon approval, or barricades from completed repair.

- (5) **TREE SAFEGUARDS.** Tree safeguards shall conform to the requirements of 609.01(E) (3).
- (F) **MEASURE AND PAYMENT.** The unit of measure for Portland Cement Concrete Sidewalk Repair and for Miscellaneous Construction will be the square yard. The actual number of square yards measured completed in place will be paid for at the contract unit price per square yard, which payment will include the removal and disposal of old material from the defective area, expansion joint material and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

#### **608.03 ASPHALTIC CONCRETE WALK**

- (A) **DESCRIPTION.** Asphaltic Concrete Walk shall consist of 2 inches of asphaltic concrete. Class "C", constructed in the areas shown in the contract documents and/or as directed by the Chief Engineer. The pertinent provisions in 403 shall apply except that a 5 ton roller may be used for compaction of the asphalt.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Asphaltic Concrete Walk will be the square yard. The number of square yards will be the actual number complete in place as measured in the field. Payment will be made at the contract unit price per square yard, which payment will include furnishing, hauling and placing asphaltic concrete and all labor, tools, equipment and incidentals necessary to complete the work.

#### **608.04 BRICK AND BLOCK SIDEWALK AND REPAIR**

- (A) **DESCRIPTION.** Brick and Block Sidewalk shall be constructed and/or repaired in those areas indicated in the contract documents and/or as directed. The sidewalk shall consist of brick or block in a mortar bed on PCC base or in a sand-cement bed on soils base as indicated in the contract documents and/or as directed. Joints shall be filled with a

sand-cement mix. The exact pattern, brick size, color, and construction details shall be as indicated in the contract documents.

In sidewalk repair, available suitable old brick and block shall be used in addition to any new brick or block required to complete the work. Delivery of brick or block from one site to another will be required and paid on a per each basis.

**(B) MATERIALS.** Materials shall meet the following requirements:

Portland Cement – 801.01

Masonry Cement – 801.02

Epoxy Mortar – 822.08(C)

Sand – 803.06

Water – 822.01

Brick – 806.01(B)

Pressed Concrete Block – 806.02

Preformed Expansion Joint Material – 807.01(A)

Cold-poured sealant – 807.02(B), natural gray color.

**(C) CONSTRUCTION REQUIREMENTS.** Premolded expansion joint material (1/2 inch) shall be placed along the back of the curbs and around structures in and abutting the sidewalk. The pre-molded material shall be removed to 1/2 inch below the sidewalk surface and this space sealed.

**(1) BRICK SIDEWALK ON PCC BASE** shall meet the following requirements:

- (a) Soils Base** – New Soils Base, if required, on existing soil, shall be brought to within 3/4 inch of proper grade. Soils base used shall meet the requirements of 804.04.
- (b) PCC Base** – The PCC Base shall be constructed on soils base, prepared per 209. PCC base shall be per 502. Depth of the PCC base shall be 4 inches. Broom or machine finishing, scoring, carbon powder and joint sealer shall not be required for PCC base.
- (c) Mortar Bed** – The mortar bed used when placing brick on PCC base shall consist of a mix of two parts by volume of well graded sand with one part by volume of masonry cement, mixed dry until the mass is uniform in color. Mixing may be done in an approved batch mixer or by hand on a clean tight surface. Enough water shall be added to the dry mix to make a comparatively stiff consistency. Mixing time shall be a minimum of 4 minutes. Immediately prior to placing mortar bed, PCC base surface shall be dampened thoroughly.

The mortar bed shall be carefully shaped to a surface approximately parallel with surface of finished brick paving. The area of mortar bed placed and rolled

in any workday shall be scheduled so that at the end of the day no bedding course remains without the brick course.

- (d) **Laying Brick** – Upon prepared mortar bed the brick shall be laid in successive courses with the better face or wire- cut side upward.

Every course of brick shall be laid true and even and brought to grade by use of wooden mallets or similar tools, and except in special cases shall be laid parallel to the curb. No course shall deviate from a straight line more than 2 inches in 30 feet. Brick laying shall take place in a continuous sequence and shall follow the completion of the bedding within 50 feet.

Immediately after laying the brick, brick surfaces shall be swept and inspected. Any imperfect brick, as determined by the Chief Engineer, shall be removed and replaced.

- (e) **Tamping Brick** – Following inspection and replacement of defective bricks, the surface shall be swept free of spalls, covered with a board approximately 3 inches thick, 12 inches wide, and 6 feet long, and shall be tamped with an approved tamper. At no time shall tamper come in direct contact with bricks, and all work shall be done as soon as possible after laying so that tamping may be completed before the bed has begun to set.

- (f) **Joint Filler** – When tamping is completed as described above, joints shall be thoroughly chocked with a dry mix of 2 parts sand and 1 part of cement by volume.

Filler shall be brought up flush with the surface of the bricks. After filling, the bricks shall be swept clean and carefully watered to saturate the joint filler, care being exercised not to displace filler from the joints. Any joints which do not remain flush with brick surfaces shall be re-chocked and watered. Particular attention shall be paid to soldier courses and those small sections of cut brick necessary to fit manholes, light poles, and obstructions within the paved area. Where directed by the Chief Engineer, these shall be completely embedded in the 2:1 mix to prevent them from working loose.

- (g) **Tree Safeguards** – Pertinent provision of 609.01(E) (3) are applicable to this item of work.

- (2) **BRICK SIDEWALK ON SAND-CEMENT BED.** Requirements of 608.04(C) (1) apply except as follows:

- (a) Construction of PCC base shall not be required for this work.
- (b) Sand-cement bedding course and joint filler shall consist of sand and portland cement in the proportion of 1 part cement and 4 parts sand by weight mixed dry until the mass is of uniform color. Mixing may be done in an approved batch mixer or by hand on a clean tight surface.

The bedding course shall be placed and shaped upon the prepared soils base so that its finished depth shall be not less than 4 inches. The bedding shall be shaped to a true surface, parallel with the surface of the finished paving, by

means of a template, and the bed shall be struck off until proper alignment is secured. The area of bedding course placed and rolled in any workday shall be scheduled so that no bedding course remains at end of day without the brick course.

If directed by the Chief Engineer, in addition to shaping with a template, the bedding course shall be compacted with a hand roller. The bedding course shall be alternately struck off and rolled until uniform alignment is secured. The roller shall be not less than 36 inches in diameter and 24 inches in width, and shall weigh not less than 10 pounds per inch of width.

After final shaping, the bedding shall not be disturbed prior to laying the brick.

**(3) BLOCK SIDEWALK ON PCC BASE or ON SAND/CEMENT BED.**  
Requirements of paragraphs (1) and (2) above apply except as specified hereunder:

- (a) **Sample** – Before work shall start, the Contractor shall submit a sample to the QA/QC Division of the District Department of Transportation for approval.
- (b) **Mock-Up** – The Contractor shall provide an in- place job mock-up of block paving work. Mock-up shall be representative of finished work in all respects, including poured concrete collars, joint fillers and sealants. Mock-up shall be used as a standard of acceptability for materials and workmanship. Accepted mock-ups will be allowed to remain as part of the completed work. Mock-up size shall be at least 10.5 feet by 10.0 feet.
- (c) **Sand-Cement Bed** – Bedding course shall consist of 1 part cement and 2 parts sand, by volume, mixed dry until the mass is of uniform color. Mixing may be done in an approved batch mixer or by hand on a clean, tight surface. Once thoroughly mixed, the mass shall be lightly moistened with water.
- (d) **Laying Paving Block** – Upon the bedding course as prepared, the pressed concrete pavers shall be laid with 1/4 inch joints, in successive, straight courses, starting perpendicular to the curb, with the better face, or non-slip finish up, and working toward the building line.

The surface edge of one paver shall be level with the next adjacent pavers so that no voids, rocking motions, or tripping hazards are encountered. Edge to edge arris shall not exceed 1/16 inch.

Unless otherwise specified in the contract documents or as directed, paving block shall be laid in a trisected running bond. Herringbone pattern shall be laid at corners.

After placement of paving block, the surface shall be covered by a board approximately 3 inches thick, 12 inches wide, and 6 feet long and shall be rolled with an approved roller. At no time shall roller come in direct contact with paving block. All work shall be done as quickly as possible after laying.

The roller shall not be less than 36 inches in diameter and 24 inches in width, and shall weigh not less than 10 pounds per inch of width.

Before the pressed concrete paving blocks are installed in place, the backs of the blocks shall be moistened with water. Blocks shall be cut to fit around catch basins, wheelchair ramps, and around light standard bases. Where cutting is required, it shall be done with a high speed masonry saw producing clean, sharp edges.

At the option of the Chief Engineer, square poured concrete collars of like color and treatment similar to the pressed concrete paving blocks shall be constructed around flagpole bases, manholes, and other small sidewalk interruptions.

For use in poured concrete areas, the Contractor shall procure from the paver supplier, bags of the same sand, cement and aggregates used in the manufacture of the pressed concrete paving blocks. The poured concrete shall be scored to match the adjacent paver pattern.

Where irregularities of line and grade exist at the building line, a shoreline of smaller blocks, poured concrete, or other treatment may be acceptable, upon approval by the Chief Engineer. In no case will blocks less than 6 inches in length be used that can be easily dislodged.

Where indicated in the contract documents, the old removable-type steel vault covers will be removed and new pan vault covers furnished and installed by the respective utility company. On the new pan covers, the Contractor shall inlay pressed concrete paving block on an epoxy mortar bed. Level of blocks shall be flush with surrounding grade. Joints shall match that of the adjacent block sidewalk as much as practicable. Small blocks, less than 6 inches in length, will be allowed for use only in the paving of vault covers.

Where building vaults are encountered below grade, the pressed concrete block pavers shall be laid on sand-cement leveling bed installed in two lifts. The first lift shall be laid and compacted as a leveling course. The second lift shall be 3/4 inch depth and treated as a setting bed for pressed concrete block pavers.

Expansion joint material, 1/2 inch wide, shall extend from the vertical face to the underground vaults up through the sand-cement beds to within approximately 1/2 inch of the surface of the Pressed Concrete Block paving. Joint shall then be sealed with sealant.

The utility company shall be notified at least 3 weeks in advance before paving work on the vault covers is scheduled to begin.

- (e) **Joints** – Joints shall be 1/4 inch maximum between paving blocks. Edges of blocks shall be beveled to 3/16 inch maximum. Combined width across beveled joint shall be 5/8 inch maximum.

Immediately after installation of the paving block, the joints shall be filled, to bottom of bevel with joint filler. Any unsuitable blocks, so determined by the Chief Engineer, shall be removed and replaced. Joints shall be thoroughly watered with a fine spray after filler is worked into the joints.

(f) **Tree Safeguards** – Pertinent provision of 609.01(E) (3) are applicable to this item of work.

(D) **MEASURE AND PAYMENT.** The unit of measure for the following items is the square yard. The number will be the actual number of square yards measured complete in place:

Brick/Block Sidewalk on PCC Base.

Brick/Block Sidewalk Repair on PCC Base.

Brick/Block Sidewalk on Sand-Cement Bed.

Brick/Block Sidewalk Repair on Sand-Cement Bed.

Payment for the various items of sidewalk and sidewalk repair will be made at the respective contract unit price per square yard, which payment will include compaction of existing soils base, furnishing and placing all materials including brick or block for new construction, PCC and mortar bed and filler or sand-cement bed and filler, preformed expansion joint material and joint sealer, epoxy mortar, water and all labor, tools, equipment and incidentals necessary to complete the work.

Payment for sidewalk repair shall also include removal and disposal of all unsuitable material and resetting existing brick or block. Any new bricks or blocks needed will be paid for on a per each basis.

## 609 CURBS, GUTTERS, DITCHES, AND PAVED FLUMES

### 609.01 PORTLAND CEMENT CONCRETE CURB, CURB AND GUTTER, AND GUTTER

- (A) **DESCRIPTION.** Portland cement concrete curb, curb and gutter, and gutter shall consist of portland cement concrete proportioned, mixed, and constructed on the prepared base course in accordance with these specifications to the grade and cross-section specified. Except as herein specified, the requirements of 501 are applicable to this specification. Repair-Replace items will include also removal and disposal of existing curb and/or gutter.
- (B) **MATERIALS.** The materials shall meet the requirements specified in 501.02, except PCC shall be Class F.
- (C) **COMPOSITION.** The proportions of materials shall meet the requirements of 817, Class F.
- (D) **CONSISTENCY.** The consistency of the portland cement concrete for this work shall meet the requirements specified in 501.15.
- (E) **CONSTRUCTION REQUIREMENTS.** Construction of portland cement concrete curb, curb and gutter, and gutter shall conform to the requirements of 501 with the following exceptions, changes, or additions.
- (1) **FORMS.** Forms for this work shall meet the requirements of 905.03(B) and shall be set in conformance with 501.06.
  - (2) **PLACING CONCRETE.** The concrete shall be placed in the forms and thoroughly compacted by working with suitable tools and a mechanical vibrator. Care shall be exercised in compacting the concrete along the faces of the form in order to insure smooth, even surfaces free from voids and honeycomb. The plastering of honeycombed areas will not be permitted.
  - (3) **TREE SAFEGUARDS.** Every effort shall be made to safeguard trees. If it becomes necessary to trim tree roots, the Contractor must notify the Chief Engineer prior to any trimming. The Contractor will then carry out his trimming operation under the supervision of the Department of Transportation's Urban Forestry Administration.  
  
In areas where new curb abuts a tree, wood forms may be used and the aggregate base directly under proposed curb may be omitted at the discretion of the Chief Engineer. Where new curb is placed directly against a tree's trunk or roots, the two shall be separated by strips of 1/2 inch preformed expansion joint. This work shall be included in the contract price for applicable PCC curb and/or gutter items.
  - (4) **REINFORCEMENT.** Reinforcement will be required in circular portland cement concrete curb, combination curb and gutter and gutter.
  - (5) **WEEP HOLES.** When directed by the Chief Engineer, the Contractor shall install in the curb an approved type of 4 inch fiber duct for weep holes. The fiber duct shall be cut so that it is flush with both the curb face forms and curb back forms. The costs of furnishing and placing materials for weep holes shall be included in the

contract unit price per linear foot per 609.01 (G) (1) or 609.01(G) (3) for Portland Cement Concrete Curb and PCC Curb and Gutter, or per cubic yard per 609.01(G) (2) for Portland Cement Concrete Curb, Gutter and/or Curb and Gutter (Variable Dimensions).

**(6) FORMING JOINTS.**

- (a) Straight Portland Cement Concrete Curb, Curb and Gutter, and Gutter –** Portland Cement concrete curb, curb and gutter, and gutter, when constructed with flexible pavements, shall have expansion joints installed at intervals of 45 feet with control joints placed between them at intervals of 15 feet. Where shorter sections are necessary for closures, no section shall be less than 4 feet. All joints, both expansion and control in curb /or gutter shall be provided with two, 3/4 inch dowel bars meeting the requirements of 807.03(B). These dowels shall be spaced a minimum of 8 inches and not more than 12 inches apart. In the curb and gutter section, one of the dowels shall be placed 4 inches from the back of the curb. All expansion joints shall be constructed with a single piece of expansion joint material meeting the requirements of 807.01(A). The expansion joint material shall be 1/2 inch below the finished surface. The control joints shall be formed by means of 14 gauge metal sheets, or other approved materials, placed 1/2 inch from the finished surface and left in place.

Where concrete curb and gutter, or gutter is constructed integrally with portland cement concrete pavement, base, or alley, expansion joints and control joints shall be formed at the same intervals and in line with the transverse joints in the pavement or base. The expansion joints shall be of the same material and thickness as used in the pavement slab. At least 2 dowel bars meeting the requirements of 807.03(B) and of the same diameter as used in the pavement shall be placed across each expansion joint and control joint in curb and/or gutter and shall be spaced as specified above for separately constructed sections.

- (b) Circular Portland Cement Concrete Curb, Curb and Gutter, and Gutter –** Portland cement concrete circular curb and gutter (for radii of 100 feet or less) shall be constructed as specified for straight curb and gutter with the following exceptions:

On radii of 100 feet or less, expansion joints shall be formed at equally spaced intervals of approximately 15 feet as is described in paragraph (a) above. On radii of less than 15 feet, one expansion joint will be required at the midpoint of the curve. The entire curve of the curb and gutter shall be reinforced by 1/2 inch deformed bars, two in the gutter section, and one approximately at the midpoint of the curb cross section above the plane of the gutter. Any lapping of the bars shall be a minimum of 10 inches.

- (7) BACKFILLING.** All backfilling behind curbs and combination curb and gutter sections shall be performed within 24 hours after removal of the rear curb forms.

Where the curb abuts a portland cement concrete sidewalk the preparation of the sidewalk foundation compacted to the density specified in Table 203.03 shall constitute backfilling. In all other cases, backfill material meeting the requirements

of 804.04 shall be placed to within 4 inches of the top of the curb and compacted to 95 percent of maximum density. The top 4 inches shall be treated as indicated in the contract documents or as directed. Material limits for backfilling will be 2 feet in back of the face of the curb.

- (8) **SEALING OF JOINTS.** All expansion joints in portland cement concrete curb, curb and gutter, and gutter shall be sealed in accordance with 501.19(A).
- (9) **FINISHING.** Portland cement concrete curb, curb and gutter, and gutter shall be finished as follows:

The curb face forms shall be removed as soon as the concrete has set sufficiently to insure against injury by such removal. The curb back forms and the gutter face forms shall remain in place for at least 12 hours. Any irregular surface shall be corrected by rubbing with an approved carborundum brick. The top surface of the concrete shall be finished true to line and grade in a smooth, neat, and even manner by means of metal trowels. When the concrete has set sufficiently, the surface shall be brushed with a fine hair brush meeting the requirements of 905.09(E). The face edge of the curb shall be finished to a radius of 1 inch and the back edge to a radius of 1/4 inch. The edges of gutters shall be finished to a radius of 1/4 inch. The edging tools shall conform to the requirements of 905.09(B). The top surface of the curb shall be tested with a straightedge meeting the requirements of 903.03, laid along the surface in the longitudinal direction. Any deviation of the top surface of the curb in excess of 3/16 inch from the straightedge shall be immediately corrected. There shall be no variation in alignment of the curb exceeding 1/8 inch. All rejected curb, curb and gutter, and gutter shall be removed and replaced without additional compensation.

- (10) **SUPERIMPOSED CURB.** Portland cement concrete superimposed curb shall be of the dimensions as shown on the standard drawings or the contract plans. It shall be constructed on the previously placed portland cement concrete pavement slab and finished in accordance with 609.01(E)(9) above.

A control joint shall be cut midway between expansion joints to a depth of 1/3 that of the height, and shall be aligned as nearly as practicable with those of the existing PCC slab to prevent spalling. Superimposed curb shall be placed as soon as possible following placement of the pavement slab.

Measure and payment for superimposed curb will be as outlined in 609.01(F)(1) and 609.01(G)(1), and the depth of the curb shall include the depth of the concrete slab upon which it is superimposed.

- (11) **TREE AND CURB.** In areas where new curb abuts a tree, wood forms may be used and the aggregate base directly under proposed curb may be omitted at the discretion of the Chief Engineer. Where new curb is placed directly against a tree's trunk or roots the two shall be separated by strips of 1/2 inch preformed expansion joint. This work shall be included in the contract price for applicable PCC or stone curb and/or gutter items.
- (12) **NARROWED REINFORCED CURB.** A narrowed reinforced curb section shall be installed as directed by the Chief Engineer when full width curb is not practicable; reinforcement shall consist of 2 No. 4 deformed bars meeting requirements of 812.02. Bars shall be equidistant from the face and back of curb, 1

bar 4 inches from the top, and 1 bar 4 inches from the bottom. Payment for narrowed curb and the reinforcing steel will be included under applicable PCC curb and/or gutter items.

**(F) MEASURE.**

- (1) **PORTLAND CEMENT CONCRETE CURB, CURB AND GUTTER.** The unit of measure for straight Portland Cement Concrete Curb or Portland Cement Concrete Curb and Gutter will be the linear foot. The number of linear feet will be the actual number of linear feet for each type of curb or curb and gutter of the width and depth specified in the contract documents, measured complete in place.
- (2) **PORTLAND CEMENT CONCRETE CURB, CURB AND GUTTER, CURB AND/OR GUTTER (VARIABLE DIMENSIONS).** The unit of measure for Portland Cement Concrete Curb, Portland Cement Concrete Curb and Gutter or Portland Cement Concrete Curb and/or Gutter (Variable Dimensions) will be the cubic yard. The number of cubic yards will be the actual number of cubic yards of variable width and depth, measured complete in place.
- (3) **CIRCULAR PORTLAND CEMENT CONCRETE CURB, CURB AND GUTTER.** The unit of measure for Circular Portland Cement Concrete Curb or Circular Portland Cement Concrete Curb and Gutter will be the linear foot. The number of linear feet will be the actual number of linear feet for each type of curb or curb and gutter of the width and depth specified in the contract documents, measured complete in place.
- (4) **PORTLAND CEMENT CONCRETE GUTTER.** The unit of measure for Portland Cement Concrete Gutter will be the square yard. The number of square yards will be the actual number of square yards for each width and/or depth of gutter specified in the contract documents, measured complete in place.
- (5) **CIRCULAR PORTLAND CEMENT CONCRETE CURB FOR ALLEY AND DRIVEWAY ENTRANCES.** The unit of measure for Circular Portland Cement Concrete Curb for Alley and Driveway Entrances will be the linear foot. The number of linear feet will be the actual number of linear feet for each type of curb of the width and depth specified in the contract documents, measured complete in place.

**(G) PAYMENT.**

- (1) **PORTLAND CEMENT CONCRETE CURB, CURB AND GUTTER.** The number of linear feet of straight Portland Cement Concrete Curb or Portland Cement Concrete Curb and Gutter, as measured in 609.01(F)(1), will be paid for at the contract unit price per linear foot, which payment will include furnishing, hauling, and placing all materials including joints, curing, and backfill, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.
- (2) **PORTLAND CEMENT CONCRETE CURB, CURB AND GUTTER, CURB AND/OR GUTTER (VARIABLE DIMENSIONS).** The number of cubic yards of Portland Cement Concrete Curb, Portland Cement Concrete Curb and Gutter or Portland Cement Concrete Curb and/or Gutter (Variable Dimensions), as measured in 609.01(F)(2), will be paid for at the contract unit price per cubic yard, which payment will include furnishing, hauling, and placing all materials including joints,

reinforcement for circular curb, curing, and backfill, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

- (3) **CIRCULAR PORTLAND CEMENT CONCRETE CURB, CURB AND GUTTER.** The number of linear feet of Circular Portland Cement Concrete Curb or Circular Portland Cement Concrete Curb and Gutter, as measured in 609.01(F)(3), will be paid for at the contract unit price per linear foot, which payment will include furnishing, hauling, and placing all materials including joints, reinforcement, curing, and backfill, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.
- (4) **PORTLAND CEMENT CONCRETE GUTTER.** The number of square yards of Portland Cement Concrete Gutter, as measured in 609.01(F)(4) will be paid for at the contract unit price per square yard, which payment will include furnishing, hauling, and placing all materials including joints, curing, and backfill, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.
- (5) **CIRCULAR PORTLAND CEMENT CONCRETE CURB FOR ALLEY AND DRIVEWAY ENTRANCES.** The number of linear feet of Circular Portland Cement Concrete Curb for Alley and Driveway Entrances, as measured in 609.01(F)(5), will be paid for at the contract unit price per linear foot, which payment will include furnishing, hauling, and placing all materials including joints, reinforcements, curing, and backfill, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

#### 609.02 STONE CURB

- (A) **DESCRIPTION.** Work shall consist of furnishing and setting new stone curbing, resetting or adjusting existing stone curbing, both straight and circular, at locations and of dimensions as shown in the contract documents or as directed. Work shall include PCC foundation, backfilling, and other incidentals necessary for complete curb installation.
- (B) **MATERIALS.**

- (1) **STONE CURB.** All new curbstones shall be first quality granite, hard and durable, of a uniformly light color from one deposit or quarry, free from seams, cracks, or other imperfections, and have a smooth splitting character.

It shall also be clean, and show no evidence of any iron rust or iron particles.

- (a) **DIMENSIONS.** Straight granite curbstone shall have a nominal width of either 5 inches or 8 inches plus or minus 1/8 inch at the top surface, a minimum width of 4 inches at the bottom surface for at least two-thirds of each curb piece or as shown in the contract documents or as directed. The front surface shall be between 12 inches and 14 inches in height. . The front surface shall be between 12 and 14 inches in height. Curbs 8 x 8 inches and 8 x 9 inches shall have a front surface of 8 inches and 9 inches respectively.

Straight curbing may be of random lengths, but no piece shall be less than 3 feet in length.

Unless otherwise shown in the contract documents, or directed, the front face shall have a batter of 1 inch in 12 inches.

Circular curb up to and including 100 feet radius shall have the same cross-section dimensions as straight curb, and shall be cut exactly true to the radius ordered. Circular curb with a 3, 6 or 15 feet radius shall have an arc length of 4.71 feet. All others shall have an arc length of 5.25 feet.

Circular curb greater than 100 feet through 200 feet radius shall consist of straight sections not exceeding 5 feet in length with ends cut to form radial joints.

- (b) **FINISH.** The top surface of curbstone shall be finished with 4-cut or 550-shot finish, or a wire cut finish to an approximately true plane, free from drill holes, and shall have no projection or depression greater than 1/8 inch.

The front face shall be at right angles to the horizontal plane of the top surface and shall be free from drill holes, except as specified in 609.02(C)(5). The front face shall have either a smooth or rough surface as indicated in the contract documents or as directed.

The smooth front face shall be finished the full height for the 8 inch and 9 inch deep curb and 2 inches greater than the height of curb reveal for the 12 inch deep curb. The smooth face shall have no projection or depression greater than 1/8 inch. Remaining depth of front face may be rough cut with depression or projections not exceeding 1-1/2 inches. The arris line between the top surface and front face shall have a 1/4 inch bullnose. A sawn finish will be an acceptable alternate.

The rough front face shall be smooth quarry split and shall have no projection greater than 3/4 inch nor depressions greater than 1/2 inch as measured from the vertical plane of the face through the top arris line, for a distance down from the top of eight inches. The remaining depth shall have no projection or depression greater than one inch measured in the same manner.

Front and back arris lines shall be straight and true with no variation from a straight line greater than 1/8 inch.

Bottom surfaces shall have no projection or depression greater than 1-1/2 inches and drill holes will be permitted.

Back surfaces shall be sawn or split approximately at right angles to the plane of the top surface. No projection or depression greater than 1/4 inch will be allowed for a distance of 4 inches down from the top. The remaining distance shall have no projection or depression greater than 1-1/2 inches. Drill holes will be permitted in the back surface but shall not show in the top arris line.

Ends of stone shall be square with the plane of top surfaces; except for curbs greater than a 100-200 foot radius where joints are cut radial, ends of the stone shall be square with the planes of the face and so finished that when set, no space more than 1/2 inch shall show in the joint for the full width of the top or down the face for 8 inches.

The remainder of the end may break back not over 8 inches from the plane of the joint (not over 2 inches from the plane of the joint for Bridge Curb).

- (2) **PCC FOUNDATION.** The PCC foundation shall be of a dry consistency, and composed of materials conforming to 817. Proportions shall be as specified in (C)(3)(b) below. The time interval for placing and compacting the dry-mix shall not exceed two (2) hours.

**(C) CONSTRUCTION REQUIREMENTS.**

- (1) **EXCAVATION FOR STONE CURB.** Excavation for setting of stone curb or resetting to a new line shall be as shown in the contract documents. The cost of this excavation will be paid for at the contract unit price per cubic yard for the type of excavation encountered. Where stone curb is reset on approximately the same line, no payment will be made for excavation as this cost will be included in the contract unit price per linear foot for the type of curb reset.

The bottom of the excavation shall be thoroughly compacted to grade. Any unsuitable material encountered shall be removed and replaced with base material meeting the requirements of 804.04. This excavation shall be paid for under the appropriate excavation item.

- (2) **LINES AND GRADES.** Before setting, resetting, or adjusting any curb, the Contractor shall check all lines and grades furnished him, by the use of string line and tees. Upon the discovery of any error in line and grade furnished, the Contractor shall immediately notify the Chief Engineer before proceeding with the work. Any curb set to an improper grade shall be removed and reset at the Contractor's expense.

(3) **SETTING AND RESETTING CURB.**

- (a) **General.** In the setting of stone curb, the joint space between the sections of curb shall be 1/4 inch with 1/4 inch preformed expansion joint filler meeting the requirements of 807.01 (A) placed therein. Before any concrete for pavement is placed against the curb, that portion of the curb against which concrete is to be placed shall be treated with a coating meeting the requirements of 802.03.

- (b) **Setting Curb.** A bed of dry-mix consisting of 5 bags portland cement, 1300 pounds of fine aggregate (sand) and 1800 pounds of No. 67 aggregate shall be placed to a minimum depth of 7 inches. Immediately after the mix has been properly compacted, the curb shall be placed upon it and set to a firm bearing by ramming with crowbars. The face of the curb must be plumb and true to line, and the top set to grade. Care must be exercised in ramming the curb to grade to prevent marring or breaking the stone. A wood shield or board shall be placed on top of the curb to prevent such damage.

After the curb has been set to line and grade, the area behind the curb shall be filled with the specified mix to within 4 inches of the top of the curb and to a width of 6 inches. That part of the bed used in setting the curb which projects into the PCC or brick gutter, base, or pavement shall be removed. Removal shall not be done until the bed has sufficiently set to prevent any damage to the portion under the curb.

- (c) **Resetting Curb.** Resetting of curb shall be performed as described for setting new curb, except that no hauling will be necessary other than the disposition of the curb within the project limits. It will be necessary to entirely remove the curb and old concrete foundations. Any curb broken due to the Contractor's negligence shall be replaced at his expense. Any curb deemed unsuitable for re-use by the Chief Engineer shall be removed and new curb, furnished either by the District or by the Contractor as determined by the Chief Engineer, shall be set by the Contractor. Payment for removal and disposal of unsuitable curb will be made under the appropriate excavation item.
- (4) **ADJUSTING CURB.** The work to be performed under this item shall consist of slight adjustment to line and grade of sections of curb which do not require complete resetting. Under this item, the removal of the curb, excavation, or replacement of concrete is not required. Adjustment shall be made by maneuvering the curb into position and ramming a dry mix under the curb to provide a firm foundation to maintain the curb in proper vertical and horizontal alignment. The cost of this mix shall be included in the contract unit price per linear foot for adjusting curb.
- (5) **DRILL WEEP HOLE IN STONE CURB.** The work to be performed under this item consists of core drilling weep holes, with a neat finish, in stone curbs for the purpose of connecting existing drain pipe (roof drains, etc.) to gutter. The diameter of the weep hole shall not exceed 4 inches.
- (6) **BACKFILLING.** After the curb and backing are in place the remaining area shall be backfilled to within 4 inches of the top of the curb with materials meeting the requirements of 804.02 and compacted to 93 percent of standard density.
- In backfilling, including replacement of unsuitable material, suitable materials excavated from the project shall be used insofar as possible. When sufficient suitable material from the site is not available, embankment or aggregate base, as directed, shall be used. Care shall be taken in this operation so that the curb will not be forced out of line. The Contractor will be required to refill any depressions that may occur after sufficient time has elapsed for settlement of the backfill. The lateral limits of this backfill shall be 2 feet from the face of curb.
- (7) **SALVAGE OF STONE CURB.** The work consists of the loading and hauling of existing stone curb to such locations off the project as may be designated by the Chief Engineer.
- (8) **TREE SAFEGUARDS.** Tree safeguards shall conform to the requirements of 107.12 and 609.01(E)(3).

**(D) MEASURE.**

- (1) **FURNISHING AND SETTING, RESETTING, ADJUSTING, AND SALVAGING STONE CURB.** The unit of measure for Furnishing and Setting, Resetting, Adjusting, and Salvaging Stone Curb will be the linear foot. The number of linear feet will be the actual number of linear feet set, reset, adjusted, or salvaged as measured complete in place. All stone curb for payment under this item shall be furnished by the Contractor.

- (2) **DRILL WEEP HOLE IN STONE CURB.** The unit of measure for Drill Weep Hole in Stone Curb will be each. The quantity will be the actual number of weep holes drilled complete.
- (3) **EXCAVATION, AGGREGATE BASE AND EMBANKMENT.** These items will be measured under the appropriate items of Division 200.

**(E) PAYMENT.**

- (1) **FURNISHING AND SETTING 8" x 12" STRAIGHT AND/OR CIRCULAR STONE CURB.** The number of linear feet of Furnishing and Setting 8" x 12" Straight and/or Circular Stone Curb, as measured above, will be paid for at the contract unit price per linear foot. This payment will include furnishing, hauling, and placing all materials. Payment will include joining, dressing up and rounding off ends at driveways, backfilling trench bottom and back of curb and all labor, materials, tools, equipment and incidentals necessary to complete the work.

Payment for straight and circular curb sections with ends cut to form radial joints shall be made at the respective contract unit price per linear foot. Circular curb greater than 100 feet shall be paid as straight curb. Measure and payment shall include all provisions outlined herein.

- (2) **RESETTING STRAIGHT AND/OR CIRCULAR STONE CURB.** Payment for Reset Stone Curb will be made at the contract unit price per linear foot for all sizes both straight and circular, which payment will include excavation, hauling existing curb sections from one location to another on the job site and from one job site to another, as well as loading and hauling old and new stone curb as required from the District property yard; all other material, placement, joining, dressing, rounding off ends at drives, backfilling and all labor, tools, equipment and incidentals needed to complete the work. Where broken curb sections are encountered as determined by the Chief Engineer, removal and disposal of broken curb shall be included as part of the work; the District will furnish replacement curb sections to the Contractor at the District property yard at no cost.
- (3) **ADJUSTING STRAIGHT AND/OR CIRCULAR CURB.** Payment for Adjusting Stone Curb will be made at the contract unit price per linear foot for all sizes both straight and circular, which payment will include excavation if necessary, all other materials, adjustment, joining, dressing, backfilling, and all labor, tools, equipment, and incidentals needed to complete the work.
- (4) **DRILL WEEP HOLE IN STONE CURB.** Payment for Drill Weep Hole in Stone Curb will be made at the contract unit price each, which payment will include drilling and all labor, tools, equipment and incidentals needed to complete the work. Payment for adjusting drain pipes and extending drain pipes to back of curb will be made under other appropriate pay items.
- (5) **SALVAGING STONE CURB.** Payment for Salvaging Stone Curb will be made at the contract unit price per linear foot, which payment will include removal, loading, and hauling to locations off the project site and all labor, tools, equipment and incidentals needed to complete the work.

**609.03 ASPHALTIC CONCRETE CURB**

- (A) **DESCRIPTION.** This work shall consist of the construction of an asphaltic concrete curb, on a prepared surface course, of the dimensions and at the locations as shown on the contract documents, and/or as directed by the Chief Engineer.
- (B) **MATERIALS.** The class of hot asphaltic concrete for curb will be stone-filled sheet asphalt or hot asphaltic concrete pavement, Class C, as directed by the Chief Engineer. 401.03 shall also be applicable.
- (C) **CONSTRUCTION REQUIREMENTS.**
- (1) **PREPARATION OF CURB FOUNDATION.**
- Asphalt curbs shall be placed on a newly laid asphalt pavement immediately following compaction of the asphalt surface. If this is impossible, as in the case of existing pavements, extra care must be taken to see that dust or any other foreign material is removed prior to laying the asphalt curb.
- (2) **PLACING CURBS.**
- (a) **General.** Placing temperature shall be the temperature specified for the type of asphalt being used. Adjustment of temperatures within the specified range shall be made in the initial stages of construction to achieve the best placement temperature. The cross-section of the curb shall be as designated in the contract documents.
- (b) **Machine Placing.** Machine-laid work usually requires no additional compaction. In areas where it is evident that compaction is inadequate, measures shall be taken to provide adequate compaction. No forms are needed for machine-placed curbs.
- (c) **Hand Placing.** Hand placing will be permitted only in areas where it is necessary to construct a transition curb section. Material placed by hand shall be tamped into place and screeded to a smooth finish in a workmanlike manner. Forms may be removed as soon as the material has cooled to air temperature.
- (d) **Tree Safeguards.** Tree safeguards shall conform to the requirements of 107.12.
- (D) **MEASURE AND PAYMENT.** The unit of measure for Asphaltic Concrete Curb will be the linear foot. The actual number of linear feet of the width and depth specified, measured complete in place, will be paid for at the contract unit price per linear foot, which payment will include all labor, materials, tools, equipment, and incidentals necessary to complete the work.

**609.04 PCC WHEELCHAIR/BICYCLE RAMPS**

- (A) **DESCRIPTION.** Work includes furnishing all materials for and construction of PCC Wheelchair/Bicycle Ramps in accordance with the contract documents, or as directed. Work also includes cutting to a neat line, excavation and disposal of all excavated materials when ramps are incorporated into an existing sidewalk and/or curb. Except as amended herein, requirements of 608.01 apply.

- (B) **MATERIALS.** Materials shall be as specified in 817 for Class F concrete.
- (C) **COMPOSITION.** The proportions for portland cement concrete used in wheelchair/bicycle ramps shall meet the requirements of 817, Class F.
- (D) **CONSISTENCY.** The consistency of the portland cement concrete for this work shall meet the requirements specified in 501.15.
- (E) **CONSTRUCTION REQUIREMENTS.** Unless otherwise directed, neither reinforcement nor darkening agents shall be used in ramp construction. Ramp surfaces shall be finished with a steel bristle broom.
- (1) **NEW CONSTRUCTION AREAS.** Ramps shall be constructed on aggregate base prepared as part of the work under other appropriate items of work. Where gutters are incorporated, the gutter section adjacent to the ramp shall be constructed monolithically with the ramp as part of this work.
  - (2) **EXISTING SIDEWALK AND/OR CURB AREAS.** The existing sidewalk, curb and/or gutter shall be cut to a neat line. Any damage to adjacent areas shall be repaired by the Contractor at no additional cost to the District. Where existing stone curbs are encountered, the curb sections affected by new ramp construction shall be removed. Wherever possible, a ramp shall be constructed within the confines of one curb section. When this is not possible, existing stone curb may have to be cut to accommodate the ramp construction. Where the resulting gap between an edge of a new ramp and the remaining curb section is less than 3 feet in length, new PCC curb shall be constructed in the gap. Where the gap is three feet or greater in length, the removed stone curb section shall be cut to proper dimensions and reset in the gap per applicable requirements of 609.02(C)(3). If the Chief Engineer determines that a section of stone curb is unsuitable for resetting, then PCC curb will be constructed. Preformed expansion joint filler shall be placed around the wheelchair/bicycle ramp flush with the finished surface.
- (F) **MEASURE.** PCC Wheelchair/Bicycle Ramps will be measured by either of the following methods as specified in the contract documents:
- (1) The unit of measure will be each. The number will be the actual number of complete ramps constructed in new and existing construction, respectively.
  - (2) The unit of measure will be the square yard.
- (G) **PAYMENT.** Payment for PCC Wheelchair/Bicycle Ramps will be made by either of the following methods as specified in the contract documents:
- (1) **NEW CONSTRUCTION AREAS.** Payment for PCC Wheelchair/Bicycle Ramps in new construction shall be made at the contract unit price per each (or per square yard), which payment will include furnishing and placing all materials and all labor, tools, equipment and incidentals necessary to complete the work.
  - (2) **EXISTING SIDEWALK AND/OR CURB AREAS.** Payment for PCC Wheelchair/Bicycle Ramps incorporated into existing sidewalk and/or curb areas will be made at the contract unit price per each (or per square yard), which payment will include cutting to a neat line, excavation and disposal of excavated materials,

cutting and resetting stone curb if necessary, furnishing and placing all materials, tools, equipment and incidentals necessary to complete the work.

#### **609.05 PORTLAND CEMENT CONCRETE DITCHES**

(A) **DESCRIPTION.** This work shall consist of constructing portland cement concrete paved drainage ditches on a prepared subgrade to the lines, grades, and dimensions as indicated in the contract documents, or as directed by the Chief Engineer.

(B) **MATERIALS.** Materials shall meet the requirements of 501.02.

Geotextile fabric shall meet the requirements of 822.09.

(C) **CONSTRUCTION REQUIREMENTS.** All work shall be done in accordance with the applicable provisions of 609 with the following modifications.

Expansion joints shall be installed in all PCC paved ditches at intervals of approximately 45 feet, with contraction joints between them at intervals of approximately 15 feet, unless otherwise directed by the Chief Engineer.

Dowel bars for load transfer devices at expansion joints shall be 1/2 inch in diameter, 16 inches in length, and spaced approximately 1 foot on centers. Dowel bars shall be placed not less than 6 inches from the edge of the ditch paving. Dowel bars at the contraction joints will not be required.

Contraction joints shall be formed by pressing a metal strip vertically downward into the soft concrete surface and removing this strip after the concrete has stiffened sufficiently to hold its form. The strip shall form a slot 3/8 inch wide at the top, and 1/4 inch wide at the bottom, with a depth equal to 1/3 the paving thickness. Alternate methods of joint formation may be used, upon approval of the Chief Engineer.

All expansion and contraction joints in the PCC ditch paving shall be sealed in accordance with the requirements of 501.19.

(D) **MEASURE AND PAYMENT.** The unit of measure for Paved Portland Cement Concrete Flumes will be the square yard. The actual number of square yards measured complete in place on the exposed surface will be paid for at the contract unit price per square yard, which payment will include excavation and disposal of surplus materials, preparation of subgrade, installation of geotextile fabric, curing, backfilling, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

#### **609.06 PAVED BITUMINOUS CONCRETE DITCHES**

(A) **DESCRIPTION.**

This work shall consist of constructing bituminous concrete flumes on a prepared subgrade to the lines, grades, and dimensions as indicated in the contract documents, or as directed by the Chief Engineer.

(B) **MATERIALS.**

The bituminous concrete mixture shall be Class B, hot asphaltic concrete pavement, and shall conform to the applicable requirements of 402.

Geotextile fabric shall meet the requirements of 822.09.

- (C) **CONSTRUCTION REQUIREMENTS.** The subgrade shall be constructed to the depth and dimensions as indicated in the contract documents.

The bituminous material shall be placed in accordance with the applicable provisions of 402.03, except that a hand tamper meeting the requirements of 904.06 shall be used for compaction.

- (D) **MEASURE AND PAYMENT.**

The unit of measure for Paved Bituminous Concrete Flumes will be the square yard. The actual number of square yards, measured complete in place will be paid for at the contract unit price per square yard, which payment will include furnishing, hauling, and placing all materials, excavation and disposal of surplus materials, preparation of the subgrade, installation of geotextile fabric, placing and compacting the bituminous material, backfilling, and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

#### **609.07 BRICK GUTTER**

- (A) **DESCRIPTION.** Brick gutter shall be constructed in the area and to the grade and pattern shown in the contract documents. The brick shall be laid in a mortar bed on a PCC base. Brick is to be laid prior to the start of any asphalt paving.

- (B) **MATERIALS.** Materials shall meet the following requirements:

Portland cement – 801.01

Sand – 803.06

Water – 822.01

Brick – 806.01 (D)

Masonry Cement – 801.02

Preformed Expansion joint – 807.01(A)

Sealant – 807.02(A)

- (C) **CONSTRUCTION REQUIREMENTS.**

- (1) **PREPARATION OF CONCRETE BASE.**

Prior to the placement of the mortar setting bed, the surface of the concrete base shall be chipped or ground as necessary to the required elevations. The base shall be thoroughly cleared of all dirt and debris and shall be free from water before any bed material is laid. If chipping is required, upon completion, the concrete base shall be blown clean of all particles before the mortar setting bed is laid. In particular, the Contractor shall ensure that the concrete base elevations adjacent to the catch basins are such that the finished brick gutter surface elevations match the details shown herein.

- (2) **MORTAR SETTING BED AND JOINT FILLER.**

- (a) The mortar setting bed shall comprise of 1 part by volume of portland cement and 2 parts by volume of sand.

- (b) Mortar joint filler shall be composed of 1 part by volume of portland cement and 2 parts by volume of sand. Mortar joint filler shall contain an approved, black colorant in an amount not to exceed 2-3 percent by weight of the portland cement. Colorant shall be of a type and quality which will not adversely affect workability, durability, setting or strength of the mortar joint filler and of a type specifically prepared for use in cement mortar.
- (3) **PLACING MORTAR SETTING BED.** The mortar mix for the setting bed shall be thoroughly mixed to uniform color and shall be free from irregularities or streaks of unmixed materials. The mortar setting bed shall be spread on the prepared concrete base to a finished depth of not more than 1 inch or less than 1/2 inch and regulated so as to be exactly parallel to the finished grade of the roadway when laid. The mortar setting bed shall be uniformly tamped, prior to laying brick.
- (4) **PLACING BRICK.** At the curb, brick is to be laid perpendicular to the curb alternating between a full brick and a half-brick at the curb. Work will start with a full brick end at the crosswalks and proceed to mid-block. The brick gutter pattern is to be completed continuously along the curb.

Laying of brick shall proceed in such manner that un-laid sections of the mortar setting bed are not disturbed. Any depressions formed in the mortar setting bed shall be corrected prior to placement of brick.

At midblock the joint width between bricks shall be adjusted within the limits specified over such a distance along the gutter that will allow the brick gutter to be completed using full width brick only.

A uniform 3/16 inch joint plus or minus 1/16 inch is to be provided between brick and between brick and granite curb. joints shall be solidly filled to the full depth with mortar joint filler and care shall be taken not to smear mortar joint filler on the surface of adjoining brick or other surfaces.

After installation, joints shall be finished by tooling with a non-staining jointer to produce a very slightly concave, smooth joint free of cracks. Special care shall be taken to properly protect brick gutter paving immediately after installation against adverse weather and too rapid drying during hot weather.

Expansion joint material shall be installed in the brick gutter and mortar setting bed at joints with the crosswalk granite shorelines. Expansion joints in the brick gutter and mortar setting bed shall also be installed over existing expansion joints located in the portland cement concrete road base. Sealant shall be applied to a depth of 1/2 inch over the expansion joint material. The sealant surface shall be flush with the brick surface.

- (5) **MEASURE AND PAYMENT.** The unit of measure for Brick Gutter will be the square foot. The number of square feet of this item will be paid for at the contract unit price per square foot, which payment will include the furnishing, hauling and installation of all materials, preparation of concrete base, disposal of excess materials, and all labor, materials, tools, equipment and incidentals necessary to complete the work.

## 610 TURF ESTABLISHMENT

### 610. 01 SEEDING

- (A) **DESCRIPTION.** This work shall consist of soil preparation, fertilizing, liming as required, seeding, mulching, and mowing all areas designated for turf establishment as specified in the Contract Documents or as directed by the Chief Engineer.
- (B) **MATERIALS.**
- (1) **SEED** shall meet the requirements of 823.03.
  - (2) **TOPSOIL** shall meet the requirements of 823.01.
  - (3) **FERTILIZER** shall meet the requirements of 823.02.
  - (4) **LIME** shall meet the requirements of 823.02(E).
  - (5) **MULCH** shall meet the requirements of 823.04.
- (C) **CONSTRUCTION REQUIREMENTS.** Unless otherwise specified, seeding operations shall be during the periods from March 1 to April 30 and from August 15 to October 31. Seed shall be mixture No. 1, mixture No. 2, or mixture No. 3 as specified for in the Contract Documents or as directed by the Chief Engineer. Seeding at other than the above dates may be allowed upon written approval of the Chief Engineer. Seeding operations shall not be performed when the ground is frozen or when soil or weather conditions would prevent proper soil preparation and subsequent operations. When hydroseeding is performed, nozzles or sprays shall not be directed toward the ground in a manner that will cause erosion or runoff. The Contractor shall notify the Chief Engineer at least 48 hours prior to beginning seeding operations.

Seed shall be furnished separately or in mixes as required in standard sealed containers. All seed shall be labeled, tagged, or marked per accepted horticultural practice and shall comply with all current state and federal regulations. Seed and mixes shall be furnished with a certification from the seed company stating type of seed, percentages of mixture, purity, germination, and weed seed. Legume seed shall be inoculated with an approved inoculant.

- (1) **PREPARATION OF SEED BED.** The Contractor shall first clear the seeding areas of all stones, clods, and debris. The preparation of the seed bed shall include, under this item, the removal of or the merging into the adjacent area any subsoil material existing back of the roadway curbing so as to permit placement of the required 4 inches of topsoil in the seeding areas. The seeding areas shall be boarded or bladed, as necessary, to eliminate any irregularities and to establish a uniform subsurface prior to placing topsoil. All areas shall be left in a drainable condition, free of pockets or depressions. The Contractor shall harrow, disk, or otherwise loosen the subsoil to a depth of 4 inches. Cultivation of slopes steeper than 3 to 1 shall be confined to horizontal scarification to a depth of 2 inches. Gullies, washes, and disturbed areas that develop subsequent to final dressing shall be repaired before they are seeded.

Following the approved sub grade preparation, the Contractor shall apply topsoil over the areas in accordance with the requirements of the Chief Engineer.

All areas to be seeded shall meet required finish grade.

- (2) **APPLYING LIME.** Lime, if necessary to adjust soil pH for grass renovation, shall be applied at the rate of 3,000 pounds per acre. Lime shall then be thoroughly mixed to a depth of 4 inches.
- (3) **APPLYING FERTILIZER.** Fertilizer shall be applied at the rate of 1,000 pounds per acre. Fertilizer shall then be thoroughly mixed to a depth of 4 inches. The area shall be scarified and raked until the surface is smooth, friable, and of uniform fine texture.
- (4) **USE OF SEWAGE SLUDGE.** The use of sewage sludge will not be permitted.
- (5) **APPLYING SEED.** Seed shall only be applied to previously prepared seedbeds.

When seed is applied with hydraulic seeders, all mixtures shall be used within eight hours after mixing.

When seed is sown with mechanical seeders, seed and fertilizer shall be incorporated to a depth not more than 1/4 in.

All leguminous seeds shall be inoculated as specified on the inoculant package label. The inoculant shall be stored at room temperatures, out of direct sunlight and away from heating units.

When leguminous seed is sown by hydraulic seeders, 10 times the quantity of inoculant required for dry leguminous seed application shall be used. Seed not used within one hour shall be re-inoculated.

When leguminous seed is sown by mechanical seeders, the seed shall be dampened with water and mixed with the inoculant. The inoculated seed shall then be mixed with the other seed to be used. Inoculated seed not used within 24 hours shall be re-inoculated.

Establishing turf shall be done using mechanical seeding, unless hydro-seeding is specified or directed by the Chief Engineer. Regardless of the method used, the finished surface of any area that is seeded shall not be rougher, more uneven or have more or larger stones, clods, roots, or other foreign materials than the area it adjoins. In built up and residential areas hand raking will be used as required to produce the required smoothness and uniformity, particularly where grading and turf establishment is to be adjacent to lawns.

- (a) **MECHANICAL SEEDING.** Following the approved seed bed preparation the seed shall then be sown. Mixtures No. 1 and No. 2 shall be sown at the rate of 200 pounds per acre or 5 pounds per 1,000 square feet. The seed shall be evenly distributed, preferably with wheelbarrow seeders, seed drills, landscape seeders, cultipacker seeders, fertilizer spreaders, or other approved mechanical seed sowing equipment when seed and fertilizer are to be applied in dry form.

Fertilizer in dry form and ground limestone, if required, shall be spread separately at specified rates and incorporated in one operation to required depth

on those areas indicated. Seeded areas shall be compacted within 24 hours after seeding has been completed.

Hand-operated seeding devices may be used when seed, fertilizer, and lime are applied in dry form. Generally, hand operated seeders shall be used only on areas which are inaccessible to mechanical seeders.

After the seed has been sown, it shall be covered to an average depth of 1/4 inch by means of a brush harrow, chain harrow, cultipacker, rake, or other approved device. Rolling of seed areas shall be done only as requested by the Chief Engineer.

- (b) **HYDROSEEDING.** The seed and fertilizer, or the seed, fertilizer, and suitable mulch shall be mixed in the needed amount of water to produce slurry and then applied under pressure at the rate indicated on the plans or in the Special Provisions. Hydraulic equipment shall be approved prior to use. When approved, mulch may be applied during or after the seeding operation. When wood cellulose mulch is to be incorporated as an integral part of the slurry mix, it shall be added after the seed and fertilizer have been thoroughly mixed. Lime, when applied hydraulically, shall be a single, separate operation. Wood cellulose mulch shall be applied at the rate of 1,500 pounds per acre or 35 pounds per 1,000 square feet. Any area inadequately covered shall be retreated as directed at no additional cost to the District.

Legume seed, if specified to be used in the seeding mix, shall be inoculated per instructions of inoculant manufacturer. The inoculums used for hydraulic seeding shall be 10 times that recommended for dry seeding. When seeding, or reseeding, fertilizing, and mulching are applied in water, compaction or rolling will not be required.

- (6) **SEED ESTABLISHMENT PERIOD.** The Contractor shall protect and care for seeded areas until final acceptance of the contract. Care shall consist of providing protection against traffic by providing approved warning signs and barricades; and shall consist of repairs to any seeded turf areas damaged by wind, water, fire, traffic or other causes. Grass shall be mowed whenever height reaches 6 inches to maintain a height of 4 inches. Damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall then be re-fertilized, re-seeded, and re-mulched as specified herein at the Contractor's expense.
- (7) **MULCHING.** Mulch shall be spread uniformly in a continuous blanket of sufficient thickness, minimum 2 inches, to hide the soil from view, taking care not to over apply. Mulch may be spread by hand or by machinery. Mulch may be spread before seeding turf but not later than 48 hours after seeding turf unless otherwise approved or directed. Anchorage is required unless otherwise specified in the contract documents. Mulch and mulch anchorage shall be applied separately from seeds unless otherwise specified in the contract documents.

Straw mulch material, as specified in 823.04(A), shall be satisfactorily secured by applying the asphalt emulsion binder, making a uniform tacky mat. It shall be applied uniformly at the rate of 0.10 gallon per square yard of mulch surface on

slopes 3 to 1 or flatter areas and 0.15 gallon per square yard of mulch surface on slope or bank areas steeper than 3 to 1 and/or as directed by the Chief Engineer.

Mulch may be blown on grass areas. The use of cutters in the equipment used for this purpose will be permitted to the extent that at least 95 percent of the mulch shall be 6 inches or more in length. When mulch is applied by the blowing method, the loose depth in place shall be no less than 2 inches and a uniform distribution and depth of mulch must be obtained.

Mulching by the "Asphalt Mix" method is also permitted. The mulch material shall be applied by blowing, and the asphalt binder material sprayed into the mulch as it leaves the blower. The binder shall be uniformly applied to the mulch at the proportion of approximately 1.7 gallons to 45 pounds of mulch or as required by the Chief Engineer; with a minimum of 1.5 gallons and a maximum of 2 gallons to 45 pounds of mulch, depending on the type of mulch and the effectiveness of the binder in securing it. All mulched surfaces shall be properly applied with asphalt binder material so that the surfaces will have a uniform appearance. Bridges, pavements, curbs, walls, and drainage structures must be adequately protected to prevent any asphalt staining. The Contractor shall take care to prevent asphalt binder from marking or defacing structures, pavements, utilities, or plant growth. Any disfigurement shall be repaired at the Contractor's expenses. Mulching which may become displaced shall be immediately replaced and secured.

- (D) **MEASURE AND PAYMENT.** The unit of measure for Seeding will be the square yard. The actual number of square yards of surface area seeded will be paid for at the contract unit price per square yard, which payment will include furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work as specified herein.

#### 610.02 SODDING

- (A) **DESCRIPTION.** Work consists of preparation of sod bed, liming, fertilizing, watering, and furnishing and placing sod as specified in the contract documents or as directed by the Chief Engineer.
- (B) **MATERIALS.**
- (1) **SOD** shall meet the requirements of 823.05.
  - (2) **TOPSOIL** shall meet the requirements of 823.01.
  - (3) **FERTILIZER** shall meet the requirements of 823.02.
  - (4) **LIME** shall meet the requirements of 823.02(E).
- (C) **CONSTRUCTION REQUIREMENTS.**

Sodding shall not be done during freezing weather, or when the ground is excessively wet, frozen, or otherwise unsuitable. The Contractor shall notify the Chief Engineer at least 48 hours prior to beginning sodding operations.

- (1) **PROCURING SOD.** The Contractor shall exercise maximum care to retain the soil existing on the roots of the sod during transporting, handling and transplanting operations. Dumping or dropping of sod from vehicles will not be permitted. Sod shall be planted within twenty-four hours from the time of harvesting, unless it is

tightly rolled, or stored roots-to-roots. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing. The maximum period of time from harvesting to planting shall not exceed forty-eight hours.

- (2) **PREPARATION OF SOD BED.** Areas to be sodded shall be boarded or bladed as needed to eliminate irregularities resulting from soil erosion and to establish an even uniform grade as required. All areas to be sodded except those with slopes steeper than 3 to 1 shall be cultivated to a depth of 4 inches to provide a reasonably firm but friable sod bed. Cultivation on slopes steeper than 3 to 1 shall be confined to horizontal scarification to a depth of 2 inches.

Areas to be sodded shall be free of any plant growth, stones 2 inches in any dimension and larger or other debris. There shall be a minimum of 3 inches of topsoil under all sod unless otherwise specified. Apply topsoil in accordance with the requirements of the Chief Engineer.

- (3) **APPLYING LIME.** Lime, if necessary to adjust soil pH for grass renovation, shall be applied at the rate of 3,000 pounds per acre. Lime shall then be thoroughly mixed to a depth of 4 inches on slopes 3 to 1 and flatter and 2 inches on slopes steeper than 3 to 1 either during or following sod bed preparation.
- (4) **APPLYING FERTILIZER.** Fertilizer shall be applied at the rate of 1,000 pounds per acre. Fertilizer shall then be thoroughly mixed to a depth of 4 inches on slopes 3 to 1 and flatter and 2 inches on slopes steeper than 3 to 1 either during or following sod bed preparation. The area shall be scarified and raked until the surface is smooth, friable, and of uniform fine texture.
- (5) **FINISH GRADE FOR SOD.** When laid in strips adjacent to paths, pavements, drain inlets and other structures, the finished sod surface shall be flush with surface of the adjacent soil and the adjacent structures. Sod laid in drainage ways, and areas to be continuously or solidly sodded shall meet the finished grades as shown in the contract documents. Grades shall be formed with special care at the junction of drainage ways.
- (6) **PLACING SOD.** Sod shall be mowed in the field to a height of not more than 3 inches within 5 days prior to lifting. All sod shall be in place within 36 hours after lifting from the source. The soil on which the sod will be laid shall be moist. The soil shall be watered prior to sodding, if so directed by the Chief Engineer. Sod shall be placed in successive strips neatly matched with staggered joints tightly butted and all openings shall be plugged with sod. In drainage ways and where continuous or solid sodding is indicated and/or specified in the contract documents, the sod shall be laid with the longest dimension parallel to the contours.

Gaps or openings which occur at paved or wall areas shall be plugged tight with sod. Sod which is small, irregular, broken, torn or has lost any soil will be rejected. After placing sod it shall be watered thoroughly and rolled with approved equipment.

On slope areas, sod shall be placed parallel to the contour, starting at the bottom of the slope. Vertical joints between sides shall be staggered. On slopes 3 to 1 and steeper, each strip of sod shall be pegged with at least (2) two 1/2 inch by 1/2 inch by 12 inch stakes placed 2 feet apart and driven flush with the top of the grass.

- (7) **SOD ESTABLISHMENT PERIOD.** The Contractor shall protect and care for sodded areas until final acceptance of the contract. Care shall consist of providing protection against traffic by providing approved warning signs and barricades; and shall consist of repairs to any sodded areas damaged by wind, water, fire, traffic or other causes. In locations where mowing is specified, the sod shall be mowed whenever height reaches 5 inches to maintain a height of 3 inches. Damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall then be re-fertilized, reseeded, and re-mulched as specified herein at the Contractor's expense.

The sod shall be watered at weekly intervals for a minimum of four weeks following installation unless otherwise specified or directed by the Chief Engineer. Additional watering shall be performed if specified in the contract documents. When watering, sufficient water shall be applied to wet the sod at least 2 inches into the sod bed. Watering shall be done in a manner that will not cause erosion or other damage to the finished surfaces. Any surfaces that have settled, become gullied or otherwise damaged shall be repaired at the Contractor's expense to re-establish the grade and conditions of the soil prior to sodding and shall then be re-fertilized and re-sodded as specified under this work.

**(D) MEASURE AND PAYMENT.**

The unit of measure for Sodding will be the square yard, with measure taken for actual surface area sodded.

Payment will be made at the contract unit price per square yard, which payment will include furnishing all labor, materials, equipment, tools, water used during planting, and incidentals necessary to complete the work.

**610.03 WILDFLOWER SEEDING**

- (A) **DESCRIPTION.** This work shall consist of preparing seed bed, furnishing and placing wildflower and companion grass seed, herbicide and mulch as specified in the contract documents or as directed by the Chief Engineer.

**(B) MATERIALS.**

- (1) **WILDFLOWER SEED MIX** shall be approved for use in the Washington, D.C. area and shall contain at least 20 to 25 different species. The mixture shall be approximately 70 percent perennials, 20 percent biennials and 10 percent annuals. The purity of species shall be 95 percent minimum. Seed germination shall range from 75 to 98 percent.
- (2) **HERBICIDE.** Herbicide shall be an approved United States Environmental Protection Agency chemical to control and prevent re-growth of undesirable vegetation. The herbicide shall be approved for type and rate of application by the Chief Engineer.
- (3) **MULCH** shall meet the requirements of 823.04.
- (4) **HYDROMULCH** shall meet the requirements of 823.04(B).

- (5) **COMPANION GRASS SEED.** Grass seed for stabilizing soil prior to germination of wildflower seeds shall be 100% Hard Fescue (*Festuca longifolia*) or Sheep Fescue (*Festuca ovina*). Grass seed shall meet standards for germination in state where seed is purchased, shall have high purity of not less than 95 percent, and shall contain no noxious weed seeds. No bluegrass, annual rye, tall fescue, orchard grass or timothy seeds shall be used.

**(C) CONSTRUCTION REQUIREMENTS**

The Contractor shall perform all herbicide placement and all seeding, scarifying and mulching operations only at times when local weather and other conditions affecting such work are normal and favorable to the proper prosecution of the work. No work shall be done when the temperature is 32°F or lower. Seeding shall not be done during windy weather, or when the ground is excessively wet, frozen or otherwise untiltable.

- (1) **PREPARATION OF SEED BED.** All existing grass, weeds, vegetation, stones and debris shall be removed from the areas to be seeded. Prior to seeding and mulching, the soil shall be hand-raked or mechanically scarified to a maximum depth of 3 inches by power rake, tine-harrow, verti-cutter or rotary tiller set on highest setting.

Two to four weeks prior to sowing seed, the Contractor shall spray a contact herbicide over the scarified seeding area. Precautions in applying herbicide shall be followed in accordance with the manufacturer's instructions and information, and shall be of a type and rate of application approved by the Chief Engineer prior to use. The Contractor shall submit daily herbicide application reports to the Chief Engineer.

- (2) **APPLYING SEED.** Seeding in the spring, before periods of anticipated rainfall, is the best recommended time for wildflower seeding. In medians and in small areas, seeding shall be applied by hand, or by a drop or cyclone spreader set to dispense seed at the rate of 7 pounds per acre, or 1/4 pound per 1,000 square feet. After seeding, soil shall be firmed with a light-weight roller, cultipacker, or other mechanical means to insure contact between seed and soil. No fertilization of wildflower areas will be required.

Companion grass seed shall be sown separately after the wildflower seeds have been sown. Grass seed shall be planted at the rate of 10 to 15 pounds per acre, or 1/4 pound per 1,000 square feet.

On steep slopes and embankments, the hydroseeding method may be used. The slurry mix of wildflower seed and water shall be applied at the rate of 7 pounds per acre, or 1/4 pound per 1,000 square feet. Wildflower or grass seed should not be immersed in water until immediately before application.

- (3) **MULCH.** The seed bed shall then be covered with mulch to a 1/4-inch thickness, or two to three times the depth of the seed. For areas one acre or larger, a mechanical seed drill may be used to sow the seeds 1/8 to 1/4 inch deep.

Hydromulching shall be applied separately, after the hydroseeding operations are completed, at the rate of 1,200 pounds per acre, or 27-1/2 pounds per 1,000 square feet. The hydromulch shall be applied in two separate passes, or applications. Only 5 to 10 percent of the quantity of hydromulch shall be applied during the first

application, so that the wildflower and grass seed will not hang up in the mulch. A second pass, using the remainder of the hydromulch, will then be applied over the first application.

- (4) **SEED ESTABLISHMENT PERIOD.** The Contractor shall care for the seeded wildflower areas until final acceptance of the contract. Care of wildflowers shall consist of keeping the wildflowers in a healthy growing condition by watering, controlling weeds, and by any other necessary operations. Care shall also consist of providing protection against traffic by providing approved warning signs or barricades, and shall consist of repairs to any seeded wildflower area damaged by wind, water, fire, traffic or other cause. Damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall be reseeded and re-mulched as specified herein. The Contractor shall mow wildflower establishment areas once a year in the autumn after the seed heads have matured, as approved by the Chief Engineer for the duration of the contract.

The wildflowers shall be watered at weekly intervals for a minimum of four weeks following installation unless otherwise specified or directed by the Chief Engineer. Additional watering shall be performed if specified in the contract documents. Watering shall be done in a manner that will not cause erosion or other damage to the finished surfaces. Any surfaces that have settled, become gullied or otherwise damaged shall be repaired at the Contractor's expense to re-establish the grade and conditions of the soil prior to seeding and shall then be re-fertilized and reseeded as specified under this work.

If the wildflowers have not filled in the planting area completely by the end of the first growing season, the bare areas will be reseeded by the Contractor in the fall, as directed by the Chief Engineer and at no additional cost to the District.

- (D) **MEASURE AND PAYMENT.** The unit of measure for Wildflower Seeding will be the square yard.

Payment will be made at the contract unit price per square yard, complete in place, and will include an acceptable stand of wildflowers and companion grass (at least 75 percent germination) and all labor including scarifying and mowing, materials including seed, mulch and herbicide, water used during planting, tools, equipment and incidentals necessary to complete the work.

#### **610.04 CROWNVETCH HYDROSEEDING**

- (A) **DESCRIPTION.** This work shall consist of soil preparation, fertilizing, liming as required, hydroseeding and mulching all slopes greater than 3 to 1 and all areas designated for crownvetch as specified in the contract documents or as directed by the Chief Engineer.

The hydroseed shall be a mixture of crownvetch seed with inoculant added, and grass seed.

- (B) **MATERIAL**

- (1) **SEED** shall meet the requirements of 823.03 – Seed Mix No. 3.
- (2) **TOPSOIL** shall meet the requirements of 823.01.

- (3) **FERTILIZER** shall meet the requirements of 823.02(B).
  - (4) **LIME** shall meet the requirements of 823.02(F).
  - (5) **MULCH** shall meet the requirements of 823.04(B).
- (A) **CONSTRUCTION REQUIREMENTS.** Hydroseeding operations shall not be performed when the ground is frozen or when soil or weather conditions would prevent proper soil preparation and subsequent operations. When hydroseeding is performed, nozzles or sprays shall not be directed toward the ground in a manner that will cause erosion or runoff. The Contractor shall notify the Chief Engineer at least 48 hours prior to beginning hydroseeding operations.
- (1) **PREPARATION OF SEED BED.** The Contractor shall first clear the hydroseeding areas of all stones, clods, and debris. The preparation of the seed bed shall include, under this item, the removal of or the merging into the adjacent area any subsoil material existing back of the roadway curbing so as to permit placement of the topsoil in the seeding areas. The seeding areas shall be boarded or bladed, as necessary, to eliminate any irregularities and to establish a uniform subsurface prior to placing topsoil. All areas shall be left in a drainable condition, free of pockets or depressions. The Contractor shall harrow, disk, or otherwise loosen the subsoil to a depth of 4 inches. Cultivation of slopes steeper than 3 to 1 shall be confined to horizontal scarification to a depth of 2 inches. Gullies, washes, and disturbed areas that develop subsequent to final dressing shall be repaired before they are hydroseeded.

Following the approved subgrade preparation, the Contractor shall apply topsoil over the areas in accordance with the requirements of the Chief Engineer.

Other areas designated by the Chief Engineer to be hydroseeded but which are covered with weeds or grass shall have the vegetation mowed or cut down to ground level. All trees and stumps shall be removed, and all clippings and debris shall be cleared from the seedbed area. Prior to hydroseeding, the soil shall be hand raked or mechanically scarified to a depth of at least 4 inches.

All areas to be hydroseeded shall meet required finish grade.

- (2) **APPLYING HYDROSEED MIX.** The mixture of crownvetch seed and companion seed shall be sown at the rate of 100 pounds per acre or 2-1/2 pounds per 1,000 square feet. Fertilizer shall be applied at 500 pounds per acre or 12 pounds per 1,000 square feet. Lime shall be applied at the rate of 2,500 pounds per acre or 60 pounds per 1,000 square feet. The pH of the soil should be 6.5 and above. If the pH is below 6.5, additional lime should be added until this level is reached. Ureaform shall be applied at the rate of 400 pounds per acre or 9 pounds per 1,000 square feet. Inoculant shall be applied at 10 times the normal rate of application for dry seeding.
- All leguminous seeds shall be inoculated as specified on the inoculant package label. The inoculant shall be stored at room temperatures, out of direct sunlight and away from heating units. Crownvetch inoculants shall consist of pure-bred cultures of Rhizobia species of bacteria and shall not be used later than the date indicated on the container or as specified. Seed not used within one hour shall be re-inoculated.

Companion seed – For spring and fall seeding, mix into seeding mixture 60 pounds per acre of 50 percent perennial rye grass and 50 percent Kentucky 31 fescue. For summer seeding, add into this mix 4 pounds per acre of weeping love grass.

The ground limestone, fertilizer, seed and inoculant shall be combined and thoroughly mixed in a slurry tank and the specified binder then added to the mix.

- (3) **APPLYING MULCH.** Mulch shall be applied hydraulically immediately after applying the slurry mix. The mulch shall be applied at 1,500 pounds per acre or 35 pounds per 1,000 square feet.
- (4) **SEED ESTABLISHMENT PERIOD.** The Contractor shall protect and care for seeded areas until final acceptance of the contract. Care shall consist of providing protection against traffic by providing approved warning signs and barricades; and shall consist of repairs to any hydroseeded areas damaged by wind, water, fire, traffic or other causes. Damaged areas shall be repaired to re-establish the condition and grade of the area prior to hydroseeding and shall then be re-fertilized, reseeded, and re-mulched as specified herein at the Contractor's expense.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Crownvetch Hydroseeding will be the square yard.

Payment will be made at the contract unit price per square yard, complete in place, and will include an acceptable stand of crownvetch (at least three healthy and flourishing crownvetch plants per square yard), including an acceptable stand of companion ryegrass, all labor, material, tools, equipment, and incidentals necessary to complete the work. Topsoil shall be paid for under a separate item.

#### 610.05 RENOVATING GRASS

- (A) **DESCRIPTION.** This work shall consist of removing all stones, trash, and debris, soil preparation, fertilizing, liming as required, seeding, mulching, and mowing all areas designated for grass renovation as specified in the contract documents or as directed by the Chief Engineer. The Contractor shall provide a uniform acceptable stand of grass as per Seed Establishment Period, 610.01(C) (6). Any unacceptable renovated grass areas shall be re-seeded at the Contractor's expense during the immediate seed sowing period.
- (B) **MATERIALS.**
  - (1) **SEED** shall be Mixture No. 1 listed in Table 823.03 and shall meet the requirements of 823.03.
  - (2) **SEED** mix for densely shaded areas will be 20 percent by weight America Kentucky Bluegrass and 80 percent by weight Pennlawn Creeping Red Fescue.
- (C) **CONSTRUCTION REQUIREMENTS.** Unless otherwise specified, seeding operations shall be during the periods from March 1 to April 30 and from August 15 to October 31. Seeding at other than the above dates may be allowed upon written approval of the Chief Engineer. The Contractor shall notify the Chief Engineer at least 48 hours prior to beginning seeding operations.

Seed shall be furnished separately or in mixes as required in standard sealed containers. All seed shall be labeled, tagged, or marked per accepted horticultural practice and shall

comply with all current state and federal regulations. Seed and mixes shall be furnished with a certification from the seed company stating type of seed, percentages of mixture, purity, germination, and weed seed. Legume seed shall be inoculated with an approved inoculant.

- (1) **PREPARATION OF SEED BED.** The Contractor shall first clear the seeding area of all stones, trash and debris; the seeding areas shall be raked to a depth of approximately 1/2 inch.
- (2) **APPLYING LIME.** Lime, if necessary to adjust soil pH for grass renovation, shall be applied at the rate of 3,000 pounds per acre.
- (3) **APPLYING FERTILIZER.** Fertilizer shall be applied at the rate of 1,000 pounds per acre.
- (4) **APPLYING SEED.** Seed shall be spread evenly with a hand-push type, calibrated fertilizer spreader not to exceed 36 inches in width. After seed is in place and approved by the Chief Engineer, the entire area shall be dragged lightly with a metal or bamboo fan rake.

Seed for densely shaded areas shall be sown at the rate of 3 pounds per 1,000 square feet.

- (5) **SEED ESTABLISHMENT PERIOD.** The Contractor shall protect and care for seeded areas until final acceptance of the contract. Care shall consist of providing protection against traffic by providing approved warning signs and barricades; and shall consist of repairs to any seeded turf areas damaged by wind, water, fire, traffic or other causes. The Contractor shall provide water as necessary to insure proper germination and a uniform stand of grass. Grass shall be mowed whenever height reaches 6 inches to maintain a height of 4 inches. Damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall then be re-fertilized, reseeded, and re-mulched as specified herein at the Contractor's expense.
- (D) **MEASURE AND PAYMENT.** The unit of measure for Renovating Grass shall be the square yard.

The actual number of square yards of surface area renovated will be paid for at the contract unit price per square yard, which payment will include furnishing all labor, materials, tools, equipment, reseeded if necessary and incidentals necessary to complete the work as specified herein.

#### 610.06 EROSION CONTROL MATTING

- (A) **DESCRIPTION.** This work shall consist of preparing the ground surface, furnishing, placing and caring for erosion control matting specified in the contract documents or as directed by the Chief Engineer.
- (B) **MATERIALS.** All erosion control matting materials shall be made of new material, clean, sound, free of rips or tears.
  - (1) **TYPE A** – Burlap shall be of standard weave with a weight of 3.5 to 5.0 ounces per square yard.

- (2) **TYPE B** – Jute matting shall be of a uniform, plain weave with warp and wet yarns of about same size, with a width of 45 to 48 inches  $\pm$  1 inch, with 78 warp ends per width and 41 wet ends per yard. Cloth shall weigh 1.80 to 1.22 pounds per running yard  $\pm$  5%.
- (3) **TYPE C** – Woven paper or woven sisal mesh matting shall be woven from twisted yarns available in rolls 45 to 48 inches wide. Matting may vary from close to open weave, ranging from 1/8 to 1/4 inch opening. Shrinkage after wetting shall not exceed 20 % of the surface area.

Matting anchor staples shall be made of No. 8 gauge steel wire, bent U-shaped with a throat width of 1 to 2 inches, and an effective driving depth not less than 6 inches.

- (C) **CONSTRUCTION REQUIREMENTS.** The time of placement shall be as specified in the contract documents and/or according to manufacturer's recommendations. No erosion control material shall be placed on frozen ground. Matting shall be placed within 24 hours after seeding operations have been completed.

- (1) **GROUND PREPARATION AND INSTALLATION.** Areas to receive an erosion control material shall be shaped, graded and compacted to the lines and grades shown in the contract documents or as directed by the Chief Engineer. Except on freshly placed topsoil, areas to receive erosion control materials shall be scarified to a minimum depth of 1 inch immediately prior to installation of the erosion control materials. All loose stones, clods, sticks, or other undesirable material over 2 inches in greatest dimension shall be removed and disposed of by the Contractor.

Matting shall be unrolled in the direction of drainage flow without stretching. Each strip of matting shall overlap the long edge of previous strip at least 4 inches. When joining ends of 2 strips, the up-channel end of lower strip shall be turned down and buried 6 inches deep in a trench. Bottom end of upper strip shall be lapped 12 inches over up-channel end of lower strip. The Chief Engineer may require any other edge exposed to more than normal water flow be buried in a similar manner. Matting edges shall be similarly buried around the edges of catch basins and other structures.

Matting shall be in firm contact with the soil in its entirety. Matting shall be securely fastened in place with staples driven vertically into the soil and flush with the surface. Staples shall be placed at 4 feet intervals along the edges and center of the matting. On all overlapping edges, staples shall be placed 12 inches apart. At all ends of matting, staples shall be placed 12 inches apart. Mats constructed of wood and hydromulch shall also be watered immediately after stapling to bond the mat with the soil. Water shall be applied so it falls on the mat like a normal rainfall. At no time shall the water be directed from a water or hydroseeder spray gun in a direct straight line to the mat.

- (2) **CARE AND REPAIR.** The Contractor shall care for the areas where erosion control materials have been placed until a satisfactory turf has developed and approved by the Chief Engineer or final acceptance of the contract. Where necessary, such care shall consist of providing approved warning signs or barricades for protection against traffic. Any surfaces that have settled, become gullied or otherwise damaged, do to the Contractor's operations, shall be repaired at the Contractor's expense to re-establish the grade and soil conditions that existed prior

to placing erosion control materials. Turf shall be re-established as specified in the contract documents.

Staples that become loose or raised, and matting that becomes loose, torn, or undermined shall be repaired promptly at Contractor expense. When directed and as part of work, any portion of matting shall be rolled with a roller weighing not over 65 pounds per foot width of the roller.

- (D) MEASURE AND PAYMENT.** The unit of measure for Erosion Control Matting will be the square yard in place. The number of square yards as measured in place will be paid for at contract unit price per square yard, which payment will include furnishing all labor, materials, tools, equipment and incidentals necessary to complete and care for the work as specified.

Measure of overlap will not be taken.

### 610.07 TOPSOIL

- (A) DESCRIPTION.** This work shall consist of furnishing and placing topsoil in conformance with the grades, limits and depths as shown in the contract documents or as directed by the Chief Engineer.

**(B) MATERIALS.**

- (1) **TOPSOIL** shall meet the requirements of 823.01.

**(C) CONSTRUCTION REQUIREMENTS.**

- (1) **PREPARATION OF TOPSOIL AREAS.** Unless otherwise directed by the Chief Engineer, areas designated to receive topsoil shall be graded so that the completed work after topsoil is placed, shall conform to the specified grades and limits. The Contractor shall shape and then scarify or till the surface of the subsoil before the topsoil is placed to permit bonding of the topsoil with the subsoil. Tillage by disking, harrowing, raking or other approved methods shall be accomplished in such a manner that depressions and ridges formed by tillage shall be parallel to the contours. Topsoil shall be applied only when the subsoil is in a loose, friable condition.

Subsoil on slopes that have been horizontally grooved in accordance with the plans shall not be loosened.

- (2) **PLACING AND SPREADING TOPSOIL.** The loose depth of topsoil shall be sufficient to allow the area to conform to the elevations shown on the plans after topsoil settles. After topsoil has been applied, large clods, hard lumps, and stones more than 2 inches in diameter; brush; roots; stumps; litter; and foreign material shall be removed from the area. When the operation is complete, the area shall be in a condition to receive seed, sod, mulch or plants.
- (3) **RESTORATION.** The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable to receive seed, sod, mulch or plants. Surplus topsoil shall be placed in other locations approved by the Chief Engineer.

- (D) MEASURE AND PAYMENT:** Topsoil will be measured in acres of surface area computed to the nearest 1/10 acre and will be paid for at the contract unit price per acre. This price shall include preparing areas to receive topsoil; furnishing, loading, transporting, and applying topsoil; finishing areas; and restoring damaged areas prior to final acceptance.

## 611 TREES, SHRUBS, VINES AND GROUND COVER

### 611.01 REMOVE TREE AND/OR STUMP

- (A) **DESCRIPTION.** This work shall consist of removing trees and/or their stumps designated on the plans or by the Chief Engineer/Arborist and shall include cutting such trees, removing their stumps and roots from the ground, and properly disposing of the material.
- (B) **CONSTRUCTION REQUIREMENTS.** All trees designated on the plans or by the Chief Engineer shall be cut in sections from the top down without danger to traffic or injury to property, public or private. All work shall conform to ANSI Standard – A 300, “Tree, Shrub and Other Woody Plant Maintenance – Standard Practice (Pruning)”.

All stumps and roots shall be removed to a depth of at least 2 feet below subgrade. Proper precaution shall be taken to protect underground utilities when removing stumps. “Miss Utility” must be contacted to verify if subsurface utilities are at the project location.

All trees, stumps, roots, and debris shall be properly disposed of by the Contractor.

When Elm trees and/or stumps are removed, it is mandatory that the complete grinding of all parts of the tree are taken to a location determined by the Chief Engineer as a preventive measure to help halt the spread of Dutch Elm Disease. No separate or additional compensation will be allowed for disposal.

- (C) **MEASURE.** The unit of measure for Remove Tree, Remove Tree and Stump and Remove Tree Stump will be each. The number of trees will be the actual number of the various sizes of trees, as listed in the Schedule of Prices, which are removed.

The size of trees shall be the true diameter measured at a point on the tree trunk 4-1/2 feet above the ground line (DBH, Diameter-Breast-Height).

Trees with multiple trunks growing from a single base shall be measured for payment as a single tree. The sum total of all stems shall determine tree size.

- (D) **PAYMENT.** The number of the various sizes of trees, trees and stumps and tree stumps removed, as measured above, will be paid for at the contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work.

### 611.02 PLANTS AND PLANTING

- (A) **DESCRIPTION.** Work consists of furnishing, delivering, planting and/or transplanting trees, shrubs, vines and ground cover, plants of types and sizes indicated on the plans and as directed, including all excavation and planting operations, plant establishment operations, disposal of waste and other incidentals needed to complete planting work.

This work shall be performed by a qualified landscape contractor who shall be approved by the Chief Engineer prior to start of work under this item.

All work done under this item shall be inspected by the Chief Engineer.

**(B) MATERIALS.** The following apply:

Plants – Plants are defined as trees, shrubs, vines, and plants of all descriptions.

- (1) **QUALITY.** All plants shall be first-class representatives of their normal species or varieties unless otherwise specified. Unless otherwise specified, all plants shall be nursery grown stock that have been transplanted or root-trimmed 2 or more times, according to the kind and size of plants. Furnished plant materials shall be certified by State or Federal Department of Agriculture to be free from disease or infestation.

The branch system shall be normal development and free from disfiguring knots, sun-scald, injuries, abrasions of the bark, dead or dry wood, broken terminal growth, insect eggs and infestations, or other objectionable disfigurements.

Trees shall have reasonably straight stems and shall be well branched and symmetrical per their natural habits of growth.

Minimum tree size shall be 2 to 2-1/2 inch caliper, 6 to 8 feet in height.

Specimen shall mean an exceptionally heavy, symmetrical tightly knit plant, so trained and favored in its development and appearance, as to be unquestionably superior in form, number of branches, compactness and symmetry.

Plant materials that are weak or that have been cut back from larger grades to meet certain specified requirements will be rejected. All plants shall be freely dug; no heeled-in plants from cold storage will be permitted.

Prior to starting work, the Contractor shall submit, in writing to the Engineer, an itemized list of sources of all plant items to be used in the contract.

The Chief Engineer reserves the right to inspect the plant material at the nursery prior to transportation to the project site. Trees shall be sealed. Cost for inspection and sealing of plant material shall be borne by the Contractor. The Contractor shall bear all costs associated with meals, lodging and transportation, i.e., air fare, auto rental, parking and tolls. Daily lodging and meal expenses shall not exceed per diem limits allowed under DC Government regulations.

Approval of plants at the nursery shall not be construed as final acceptance of the material. The plant material will be inspected again upon arrival at the project and after installation.

- (2) **PLANT NAMES.** All scientific and common plant names shall be per “Standardized Plant Names”, as adopted by the American joint Committee on Horticultural Nomenclature.

All plants delivered shall be true to name and legibly tagged with the names and sizes of materials.

- (3) **GRADING STANDARDS.** Grading of plants, including Balled and Burlapped Specifications, Bare Root Specifications, Nursery, Collected, Container Grown and Seedling Stock shall be per “USA Standard for Nursery Stock”, as approved by the American Association of Nursery-men, Inc., latest edition (ANSI Z60.1).

- (4) **BALLED AND BURLAPPED PLANTS.** Balled and burlapped (B&B) plants shall be dug so as to retain as many fibrous roots as practicable, and shall come from soil which will form a firm ball. The soil in the ball shall be the original and undisturbed soil in which the plant has been grown. The plant shall be dug, wrapped,

transported, and handled in such manner that the soil in the ball will not be loosened to cause stripping of the small and fine feeding roots, or cause the soil to drop away from such roots.

- (5) **PLANTING SOIL MIX.** Mix shall be 5 parts top-soil per 823.01 by volume thoroughly mixed with 4 pounds of granular 5-10-10 fertilizer with trace elements such as iron, manganese, boron, zinc, molybdenum, and copper added per cubic yard of mix. Ingredients shall be delivered separately and thoroughly mixed before use.

Thoroughly composted and processed leaf mold organic matter may be added, if available, and approved by the Chief Engineer/Arborist.

- (6) **PEAT MOSS.** 823.06(A)
- (7) **STAKES.** 822.12(D). Malleable iron, arrow-shaped anchors, or oak stakes, as approved by the Chief Engineer, may be used. Chain loc must be attached to the top of stakes that have been driven into the ground and will provide protection for the tree.
- (8) **ANTIDESICCANT.** Antidesiccant, for retarding excessive loss of plant moisture and inhibiting wilt, shall be an approved emulsion which will provide a film over plant surfaces permeable enough to permit transpiration. Antidesiccant shall be used only after approval.
- (9) **TANBARK, HARDWOOD, AND ROOTBARK MULCH.** Mulch shall be medium grade and free of matter injurious to plant growth.
- (10) **MICROPORE FERTILIZER RELEASE PACKETS.** Micropore fertilizer release packets shall be used during the planting in accordance with packet manufacturer's instructions, or as specified. Each packet shall be sealed in a polyethylene laminated envelope and shall contain a minimum soluble fertilizer analysis of 16 percent nitrogen, 8 percent phosphorus and 16 percent potash. Packets shall be 4 ounces, 8 year release packages as approved by the Chief Engineer.
- (11) **HERBICIDES.** Herbicide shall be approved for type and rate of application by the Chief Engineer before use.

**(C) CONSTRUCTION REQUIREMENTS.**

- (1) **PLANTING SEASONS.** Unless otherwise directed in writing, planting shall be done during the following seasons:

Deciduous Plants – October 15 to May 1

Evergreen Plants – March 15 to June 1 and September 15 to December 1

Planting and plant establishment periods for Spring Planting Season and Fall Planting Season are shown on Schedules 611.02-1 and 611.02-2 respectively.

No planting shall be done in frozen or snow covered ground or when the soil is in an unsatisfactory condition for planting.

- (2) **DELIVERY AND INSPECTION.** The Contractor shall notify the Chief Engineer not less than 2 days in advance of plant delivery. All plants shall be available for inspection before being dug. The Contractor shall furnish the Chief Engineer complete information concerning plant source of supply. At the option of the Chief Engineer, a certified Arborist will accompany the inspector.

Only trees from the District Department of Transportation's street tree list shall be selected.

All trees and a representative sample of shrubs shall be sealed. Transportation for inspection and sealing shall be furnished by the Contractor as part of work. All plants shall comply with state and federal laws controlling inspection for plant diseases and insect infestations, and the Contractor shall deliver to the Chief Engineer all required inspection certificates. All shipments shall include a plant list giving detailed descriptions of the plants and the date of shipment.

- (3) **SUBSTITUTIONS.** When specified plants are not available at time of planting, the Contractor shall submit written evidence from at least 3 competent sources that specified plants are unavailable. If substitution is approved, plant items in the contract which are similar in size and type and which will perform the intended function shall be used at the respective contract price. If existing plant items are not appropriate and if the Chief Engineer and Contractor can mutually agree on a suitable substitution at the same contract unit price or less, the substitution will be approved.
- (4) **PROTECTION AND TEMPORARY STORAGE.** The Contractor shall keep all plants moist and protected from drying out. Protection shall include the time when plants are in transit, in temporary storage or on the project awaiting planting. Plants will be inspected by the Chief Engineer at the project site and approved prior to planting.

Plants failing to meet specifications, showing signs of improper handling or arriving with broken seals, broken or loose balls, inadequate protection for tops or roots, shriveled, dry or with damaged roots will be rejected. Rejected plants shall be immediately removed from the site and replaced.

Care shall be taken in handling plants to prevent injury to branches or roots. The solidity of balled and burlapped plants shall be carefully preserved.

Plants delivered but not scheduled for immediate planting shall be protected as follows:

Bare root plants shall be separated, roots properly spread and puddled in with moist topsoil into a heeling-in trench.

Balled and burlapped (B&B) plants shall have the earth balls covered with sawdust, wood chips or other suitable material and kept in a moist condition.

- (5) **LAYOUT.** Plant locations and beds shall be staked on the project site by the Contractor. Stakes shall be provided by the Contractor, driven at least 6 inches into the ground and shall remain until all work in the area is complete. The Chief Engineer may adjust plant locations to meet field conditions.
- (6) **PLANT PIT AND BED EXCAVATION.** Prior to excavating for plant pits and beds, locations shall be approved. Each plant shall be placed in a individual pit unless otherwise shown on the plans.

Plant beds on slopes 3 to 1 and flatter shall be prepared by removing all soil, weeds, roots and other objectionable material unsuitable for backfill.

The bed shall then be cultivated by either rototilling, backhoeing, or picking to a depth of 6 inches for ground covers, or to the proper depth for shrubs, as shown on the Plans.

Ground cover planting holes shall be dug through the mulch with one of the following; hand trowel, shovel, bulb planter or hoe. Before planting, non-biodegradable pots shall be removed. Root systems of all potted plants shall be split or crumbled.

The ground cover (either potted or bare root) shall be planted so that the roots are surrounded by soil below the mulch. Potted plants shall be set so that the top of the pot is even with the existing grade. Bare root plants shall be covered up to the crown of the plant or the soil level.

On slopes steeper than 3 to 1, plants shall be planted in individual pits within the bed area. Existing grass or other soil stabilizing growth between pits shall be cut to a height of 2 inches and the entire bed area mulched to a depth of 4 inches.

Pits shall be excavated to sizes shown on plans with vertical sides and horizontal bottom surfaces. Excavated material shall be removed from the site.

Where trees are to be installed contiguous to underground utility lines, the Contractor shall have a representative from each applicable utility company stake-out in the field the exact location of the utility conduits and appurtenances before the pits are dug.

The Contractor shall not excavate any closer than 8 inches to the backface of curbs. Excess PCC foundation for PCC or stone curb or PCC sidewalk which protrudes into planting pit shall be carefully chipped and removed by the Contractor to allow proper placement of tree ball. No additional compensation will be allowed.

Plant pits directed to be abandoned after excavation is started, due to unsuitable conditions, shall be backfilled with borrow embankment fill and compacted to specifications of AASHTO T-180, Method D, in 6 inch layers to subgrade.

The area shall then be seeded or sodded as directed. Payment for this fill and seed or sod will be made under respective pay items.

- (7) SETTING PLANTS.** All plants shall be set plumb. The tree and shrub pits shall be deep enough to allow 1/8 of the ball to be above the existing grade. The top of ball shall not be covered with soil and the root flare shall be visible. Facing and/or orientation of plants shall be as directed.

Plants pits shall be promptly backfilled and tamped. Under no condition shall any pit remain open at night unless it is properly barricaded.

Planting of trees and shrubs may be done with approved mechanical equipment. When this method is used the planting pit must be twice the size and of the same shape as the earth ball on the plant to be moved; planting soil mix backfill will be required. The depth of the hole must be equal to the depth of the root ball.

Micropore fertilizer packets shall be placed next to the root zone of the plant ball, 6-8 inches deep, before the plant pit is backfilled with the planting soil mix.

The following schedule shall be followed unless otherwise specified in the manufacturer's instructions:

Trees – 1 packet per 1 inch of caliper.

Shrubs – 1 packet for shrubs 12 to 18 inches in height and 2 packets for shrubs 19 inches to 4 feet in height.

Planting soil mix shall then be carefully worked around and over the roots and thoroughly and properly settled by firming or tamping. Thorough watering or puddling shall accompany backfill around plants. Earth saucers or water basins at least 4 inches deep for trees, and 3 inches deep for shrubs, shall be formed about individual plants with a diameter equal to that of the plant pit.

Balled and burlapped (B&B) plants shall be carefully placed in the prepared pits so as to rest in a firm, upright position. Plants shall be handled and moved only by the ball. Planting soil mix shall then be filled in around the plant ball to half the depth of the ball, then tamped and thoroughly watered. The burlap and wire basket shall then be cut away and removed from the upper half of the ball, after which the remainder of the planting soil mix shall be placed. Earth saucers or water basins shall then be provided and the plant thoroughly watered.

Container grown stock shall be removed from the container before planting.

Seedling pines shall be planted in 6 inch by 6 inch by 8 inch deep pits.

Plant beds shall be neatly edged. Plant beds on slopes steeper than 3 to 1 shall be constructed with a 3 inch shoulder around the lower edge.

Groundcover plants may be planted after the mulch has been placed.

- (8) **FERTILIZING.** During the next planting season following spring or fall planting, all plants shall be fertilized once at the rate specified by the manufacturer for the size of plant.
- (9) **WATERING.** All plants shall be thoroughly watered during and immediately after planting and at such intervals during the plant establishment period as needed. Water shall not contain elements toxic to plant life. At each watering the soil around the plants shall be thoroughly saturated.
- (10) **STAKING.** No guying of trees will be permitted. Staking must be installed with chain loc attached to the stakes.
- (11) **PRUNING.** Pruning shall be done before or immediately after planting to remove damaged or broken branches. All pruning shall be done by experienced personnel with properly conditioned equipment and in keeping with accepted horticultural practice. Trees with pruned terminal leaders will be rejected.
- (12) **MULCHING.** Mulch shall be placed over all pit and saucer areas of individual trees, shrubs and over the entire area of plant beds to 2 to 3 inch depth within 3 days after planting. Mulch shall not touch the bark of the tree.
- (13) **RESTORATION AND CLEAN-UP.** Excess and waste material shall be removed daily. When planting in an area has been completed, the area shall be thoroughly cleaned up. Where existing grass areas have been damaged or scarred during planting operations, the Contractor shall restore disturbed areas to their original condition as directed as part of work. The Contractor shall clean up all debris and leave the project in an acceptable condition.
- (14) **GUARANTEE PERIOD & REPLACEMENTS.** The acceptability of plants furnished and planted will be determined at the end of a two (2) year guarantee period during which the Contractor shall employ all practicable means to preserve the plants in a healthy growing condition. Care during this period shall include

watering, cultivating, pruning, repair and adjustment of stakes, and other standard proper care as directed. Plants, saucers, and beds shall be kept weed free. Remulch as necessary to maintain mulch depth as shown. The Contractor shall be responsible for removal of stakes and chain locs at the end of the 2 year guarantee period.

Dead and unsatisfactory plants as directed shall be promptly removed from the project. An inspection by the Contractor and the Chief Engineer will be held 30 days before the start of the planting season to determine plant acceptability and number of replacements. During the next planting season following completion of actual spring or fall planting, all dead and unsatisfactory plants shall be replaced in kind and size with live healthy plants installed per specifications at the Contractor's expense.

Alternate or substituted varieties of plants shall be used only if approved. A final inspection of all plants will be held after the replacement planting has been completed.

If the Contractor fails within 10 days to satisfactorily care for and replace plants as needed or ordered, the District may proceed with labor, equipment, and material to perform the work, with the cost of such work charged to the Contractor.

The Contractor will not be responsible for theft or damage to plants by vehicles or vandalism following completion and approval of the construction portion of planting.

- (D) MEASURE AND PAYMENT.** The unit of measure for plants will be per each. Payment for Plantings will be made at the contract unit price per each, which payment will include furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work.

On the planting construction completion date, the Contractor may receive up to 85 percent of plant pay item contract prices for accepted plants. The balance will be paid prorated as required work is performed during the plant establishment period. Final payment will be made at the end of the contract and upon removal of stakes and chain locs.

### 611.03 TRANSPLANTS AND TRANSPLANTING

- (A) DESCRIPTION.** Work includes:

1. Digging up and heeling-in plantings in the areas specified.
2. Replanting these plants.

This work shall be performed by a qualified Landscape Contractor who shall be approved by the Chief Engineer prior to start of work under this item.

All work done under this item shall be inspected by the Chief Engineer.

Upon request from the Chief Engineer, the Contractor shall furnish the unit prices for transplantings from which he arrived at contract lump sum price. These unit prices will be used in case of "adds" or "deducts".

- (B) MATERIALS.** Transplanting materials shall meet the following requirements:

Topsoil – 823.01

Planting Soil Mix – 611.02(B)(5)

Peat Moss – 823.06(A)

Peat Humus – 823.06(B)

Stable Manure – 823.02(C)

Stakes – 822.12(D)

Antidesiccant – 611.02(B)(8)

Tanbark, Hardwood, and Rootbark Mulch – 611.02(B) (9)

Chain loc – as per contract documents

**(C) CONSTRUCTION REQUIREMENTS.**

**(1) TRANSPLANT PREPARATION.** Care shall be exercised in preparing plants for movement to assure that they are dug with skill and moved to their new locations in good condition. Transplantings shall be sprayed with a wilt preventive antidesiccant spray material before digging.

Transplantings shall be dug, balled and burlapped and plat-formed if directed. Size of ball shall be at least one-fourth larger than that specified for that size planting in the A.A.N. Standards for Nursery Stock. Work shall be performed in accordance with best horticultural practice.

Transplantings shall be moved to a temporary location to be designated by the Chief Engineer where the plant material shall be heeled-in. Plants shall be heeled-in in moist soil or peat moss.

The Contractor shall provide all necessary care for plant material while they are heeled-in including watering.

Upon completion of construction, the plants shall be installed in locations as shown on plans or as directed by the Chief Engineer.

**(2) EXCAVATION.** All pits shall be excavated to sizes detailed, with vertical sides and horizontal bottom surfaces.

Where trees are to be installed contiguous to underground utility lines, the Contractor shall have a representative from each applicable utility company stake-out in the field the exact location of the utility conduits and appurtenances before tree pits are dug.

The Contractor shall not excavate any closer than 8 inches to the backface of curbs. Excess PCC foundation for PCC or stone curb or PCC sidewalk which protrudes into planting pit shall be carefully chipped and removed by the Contractor to allow proper placement of tree ball. No additional compensation will be allowed.

Excavated material shall be removed from planting areas. All backfilling for the plants and the forming of plant saucers shall be done with planting soil mix only.

Plant pits shall be backfilled immediately with planting soil mix specified herein. Ingredients shall be delivered separately to approve mixing site and mixed completely before backfilling. Under no circumstances shall any plant pit remain open overnight unless it is properly barricaded. Backfill shall be firmly tamped throughout the entire pit area so that excessive settling will not occur.

Any damage to existing grass areas shall be acceptably repaired, as required by the Chief Engineer, and at no expense to the District.

**(3) PLANTING.** Planting will not be permitted when ground is frozen or wet.

All seals and tags shall be removed before final inspection.

All trees and shrub pits shall be deep enough to allow 1/8 of the ball to be above the existing grade. Top of the ball shall not be covered with soil. Root flare must be evident just above ground level.

Bare root plants obtained from collected areas shall be set at such a level so that after settlement the depth will be the same as it was in the field or native stands.

All plants shall be set vertically and the soil mix shall then be filled in around the plant balls to half the depth of the balls and tamped. The remaining burlap around the top half of the plant balls shall be loosened cut away and removed. The remainder of the pit shall then be filled with the soil mix tamped and watered, all within the same planting day. Roots of bare root plants shall be properly spread out and the soil mix carefully worked in around them. Soil mix shall be thoroughly tamped into place and watered, all within the same day of planting. Plants shall be removed from pots before planting.

Care shall be taken during backfilling, tamping, and watering to avoid damage to roots and to prohibit air pockets. Any root bruised or broken before or during planting shall be pruned immediately to sound tissue with a clean cut.

Watering shall mean full and thorough saturation of all backfill in the pits on the day the plants are planted. Water shall be applied only by open end hose at very low pressure. In no case shall hoses from tank trucks be laid across ramps, roadways, or other pavements.

Upon completion of planting, outline of plant beds shall be neatly edged. A 3 inch shoulder of planting soil mix or excavated top soil shall be placed at the lower edge of plant beds on slopes. Individual plant pits shall be furnished with a shoulder of soil placed outside of rim of the pits to form a saucer over the entire area of the pits. In shrub beds, the soil shoulder around individual shrubs or trees shall consist of plant soil mix as detailed on plans.

**(4) MULCHING.** All plant areas and pits shall be mulched. Mulch shall be spread to the thickness specified on the plans over the entire area of the pits and plant areas. Mulch shall be raked to an even surface to within 3-4 inches of the tree trunk. All mulch shall be applied within 4 days after planting.

**(5) STAKING.** All stakes shall be installed within 24 hours of the day the trees are planted. Stakes shall be neat and secure with chain locs.

**(6) CHAIN LOCS.** Chain locs shall be attached to the top of three five (5) foot stakes which are placed in a triangular formation two (2) feet away from the tree, and not attached to the tree.

**(7) PRUNING.** Broken or badly bruised branches shall be removed with a clean cut. Pruning shall be done by skilled technicians in accordance with standard horticulture practice. Pruning of terminal leaders will not be permitted.

**(8) CLEANUP.** During the course of planting, excess and waste materials shall be removed daily. Areas shall be kept clean and all reasonable precautions taken to

avoid damage to existing structures, plants, and grasses. When planting in an area has been completed, the area shall be thoroughly cleaned up. Existing grass areas which have been injured by the work shall be re-graded and seeded according to 610.01, and the entire areas when completed shall be neat and clean.

The Contractor will not be responsible for the transplantings once they have been transplanted and the Chief Engineer records them as acceptable.

The Contractor will be liable at his expense for replacement of any transplanting which dies or becomes unsatisfactory due to the Contractor's negligence.

- (D) MEASURE AND PAYMENT.** The unit of measure for Transplants and Transplanting will be the job. Payment will be made at the contract lump sum price, which payment will include furnishing all labor, tools, equipment, materials and incidentals needed to complete the work.

#### **611. 04 PRUNING TREES**

- (A) GENERAL.** Work under these items includes pruning of trees in the project area as specified in the contract documents or as directed by the Chief Engineer and designated representatives of the Urban Forestry Administration to facilitate performance of construction activities.
- (B) CONSTRUCTION METHODS.** Pruning shall be done by a certified Arborist or Professional Horticulturist in accordance with accepted standard horticultural practice. Prior to performing any work, the Contractor shall submit the qualifications of the workers or subcontractors to the Chief Engineer for approval. Included shall be descriptions of similar work sufficient to satisfy the Chief Engineer and the Urban Forestry Administration that the workers possess sufficient experience to properly perform the work.

The selection of trees and subsequent pruning shall be directed by the Chief Engineer in coordination with an arborist of the Urban Forestry Administration. The trees shall be pruned using hand pruners, lopping shears, pruning saws or chain saws. Each designated tree shall be pruned with due regard for the natural form and growth characteristics of the species. Pruning shall be kept to a minimum with only that amount removed to allow the specified work to be accomplished.

Trees shall be pruned with a clean cut. The main leader shall not be cut. If side branches are cut to balance the tree, all cuts shall be made outside the branch collar to encourage the healing callus to develop. All accumulated plant material shall be removed daily from the project and disposed properly.

- (C) MEASURE AND PAYMENT.** The unit of measure will be per each designated tree pruned. Payment for these items will be made at the contract unit price per each, which payment will include careful pruning of the tree and proper disposal of removal plant material and all labor, tools, equipment, materials and incidentals required to satisfactorily complete the specified work.

**611.05 TREE BOX DRAINAGE-AERATION**

- (A) **DESCRIPTION.** Work includes the preparation for and installation of various components for drainage and aeration for tree boxes as described herein and as detailed on the plans.
- (B) **MATERIALS.**
- (1) Gravel shall meet the requirements of 803.02 for Grading No. 57 or 67
  - (2) Filter Screen shall be fiberglass mat of long, strong textile-type glass fibers, bound together with permanent thermosetting resin, and shall meet the requirements of MIL 1 22033, Type 1, Class 2, and shall be ¼ inch to ½ inch maximum thickness. Consistency of the mat shall be such as to prevent soil from passing through but allow the free flow of water.
  - (3) Perforated Fiber Pipe shall meet the requirements of AASHTO M 177 and shall be 4 inches in diameter and a minimum of 2.5 feet in length.
  - (4) Sand, if used for filter or for placement under plants, shall be as per 805.02.
- (C) **CONSTRUCTION METHODS.** Vertical sump holes in the bottom of the tree pits shall be made with a post hole digger or power auger. These shall be 8 inches in diameter and 3 feet in depth. Sump holes and the bottom 8 inches of the tree pit shall be backfilled with gravel, then level.
- The fiberglass filter screen shall be placed on top of and completely cover the gravel.
- During placement of backfill around plants in tree pit, perforated fiber pipe shall be positioned vertically at proper locations and elevation and filled with gravel.
- (D) **MEASURE AND PAYMENT.** The unit of measure for Tree Box Drainage-Aeration will be per each. Payment will be made at the contract unit price per each, which payment will include furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work.

**611.06 TREE GUARDS**

- (A) **DESCRIPTION.** This work consists of furnishing and installing protective tree guards of the rigid steel mesh type as indicated in the contract documents or as directed by the Chief Engineer.
- (B) **MATERIALS.** Perforated Steel Mesh – Perforated steel mesh shall be one inch square holes, 3/16 inch bar, 18 gauge, 71 percent open area.
- Steel straps – Steel straps shall be 1 inch x 3/16 inch and shall conform to the shape and length as shown on the plans.
- Steel Channel – Steel channel shall be as per 815.01(A) and shall be 1 inch x 2 inches x 1/8 inch carbon steel. (See plans for details).
- Bolts – Bolts shall be ¼ inch diameter hex head 1-1/4 inch long with ¼ inch nut.
- Paint – Primer shall meet the requirements of 811.03(A); enamel shall be gloss black alkyd.
- Touch up will be required in field as directed by the Chief Engineer to repair damage to painted areas during construction.

**(C) CONSTRUCTION REQUIREMENTS.**

**RIGID STEEL MESH TREE GUARD.** Tree guard units as detailed in the contract documents shall be completely fabricated in the shop. Steel mesh shall be tack welded to the steel straps every 3 inches.

Mesh, steel straps and channels shall be given one prime coat and two (2) coats of alkyd enamel in the shop. All surfaces shall be dry before shipment.

The prefabricated sections shall be installed in the field around trees as directed by the Chief Engineer.

- (D) MEASURE AND PAYMENT.** The unit of measure for Rigid Steel Mesh Guards will be per each. Payment will be made at the contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work.

**611.07 TREE PROTECTION AND REPLACEMENT**

- (A) DESCRIPTION.** Work under this item includes providing protection for existing trees within the project limits during construction operations. Work shall include protection by fencing of all trees within the project boundaries as indicated on the contract documents.

The Contractor is liable for replacement and repair of trees or compensation for trees damaged or killed through neglect or failure to apply tree protection during construction operations.

Failure of the Contractor to implement tree conservation measures or tree replacement, as directed by the Chief Engineer, will result in compensation or liquidated damages to the District according to the schedule of payment contained herein.

- (B) METHODS AND MATERIALS.** Protection from damage caused by the Contractor’s equipment or carelessness shall consist of the following methods and measures:

- (1) All trees to be preserved shall be protected against damage during construction operations by fencing. The tree protection fencing shall be placed before any excavation or grading has commenced. Details of the minimum acceptable tree protection are shown in the contract documents.
- (2) No equipment, trailers or materials may be placed within the drip line of existing trees to be retained within the project limits with the exception of paved areas or areas to be paved.
- (3) Any damage done to existing tree crowns or root systems shall be repaired immediately by the Contractor under the direction of an arborist from the District’s Urban Forestry Administration.
- (4) If any trees not designated to be removed are severely injured or killed by the Contractor’s operations for any reason, they shall be replaced in kind by the Contractor at no additional cost to the District, or by payment in liquidated damages according to the following schedule:

2 to 6 Inch DBH	\$ 90.00 per DBH Inch
Over 6 to 12 Inch DBH	\$100.00 per DBH Inch
Over 12 Inch DBH	\$110.00 per DBH Inch

The diameter of the tree trunk shall be measured breast high (4 to 5 feet) above the ground. Replacement shall be done on a DBH inch per DBH inch basis (one DBH inch of replacement trees per DBH inch of damaged trees). Trees replaced in kind shall be planted in accordance with 611.02. The Chief Engineer, shall be solely responsible for determining whether or not a given injury is sufficient to warrant repair, replacement or monetary compensation by the Contractor.

(5) Materials shall meet the following requirements:

Tree Protection Frame: The tree protection frame shall consist of four (4) posts, four (4) feet high placed at the four corners of the existing tree pit with a minimum delineated surface area of four (4) feet x nine (9) feet. The four placed posts shall be joined with 2 " x 4" lumber across the top at the 36" mark and across the bottom on all sides. The tree protection frame shall be covered by stapling a thirty-six inch high heavy weight orange snow fence on all sides of the tree frame. This practice shall be set up at every tree that is contained within the construction site as well as all project-related work areas from start to finish of the project.

- (C) **MEASURE AND PAYMENT.** The unit of measure will be the job. No direct measure will be taken. Payment for Tree Protection and Replacement will be made at the contract lump sum price for tree protection, which payment will include all labor, tools, materials, equipment and incidentals needed to complete the required work.

No payment will be made for repair and replacement in kind for trees damaged or killed due to the Contractor's operations. This work will be performed at the sole expense of the Contractor.

### 611.08 TREE ROOT PROTECTION

- (A) **DESCRIPTION.** This work includes precautions to be taken while performing utility trenching, roadway work, sidewalk and curb installation. Work also includes furnishing and placement of prepared planting soil mix and fertilizer backfill around exposed and disturbed roots, and the disposal of excess materials, branches and debris.
- (B) **CONSTRUCTION METHODS.** Construction operations adjacent to existing trees shall be performed in accordance with 611.07(B)(5) to prevent trunk, crown and root damage. Tree roots shall not be cut unless specifically authorized by the Department of Transportation's Urban Forestry Administration.. If authorized, pruning shall be performed under their supervision in accordance with 107.12 and 609.01(E)(3), or by a certified arborist meeting their approval. When authorized by the Chief Engineer, the Contractor may cut minor roots (less than 2 inches in diameter) with his own forces. When trenching or when old curb, gutter or sidewalk is removed, damp burlap shall be placed over exposed roots and kept damp at all times until the new work is placed. Exposed or cut roots shall be backfilled with prepared fertilizer-enriched planting soil mix to encourage root growth.

In all operations involving utility trenching, the work shall be performed as per 207.03. Whenever possible, root cutting shall be avoided; no part of the root ball shall be trenched. Utility trenching shall not be allowed if tree roots are within the trench area. These excavations shall be augured or tunneled, as necessary, to prevent root cutting.

In curb installations, it is recommended that curbing be bridged across the length of the tree space, without a dry mix backing block, in order to avoid any trenching excavation in the vicinity of the roots. The length of curbing placed adjacent to the length of the tree space shall then be dowelled or pinned to the standard curb construction outside the tree space.

Trees located adjacent to construction work shall be watered at ten (10) day intervals throughout the growing season. The Contractor shall supply watering bags of same type that are sold in the industry and fill them according to the manufacturer's specifications or at a minimum keeping the bag full during the growing season. No equipment, trailers or material shall be placed within twenty (20) feet or within the drip lines of any tree to be saved, whichever is greater.

Any damage done to existing tree trunks, crowns or root systems shall be repaired immediately by the Contractor, at his expense, under the direction of an arborist from the Department of Transportation's Urban Forestry Administration.

Protect root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems.

Maintain tree protection zones free of weeds and trash.

Install Mycorrhizal Fungal Inoculation inside the tree protection zone as required by the manufacturer.

Where re-grading is required, the following shall apply:

**Minor Fill:** Where existing grade is 6" or less below elevation of finish grade, fill with material as shown in the Contract Drawings. Place material in a single uncompacted layer and hand grade to required finish elevations.

**Moderate Fill:** Where existing grade is more than 6 inches (150 mm) but less than 12 inches (300 mm) below elevation of finish grade, place drainage fill, filter fabric, and topsoil on existing grade as follows:

Carefully place drainage fill against tree trunk approximately 2 inches (50 mm) above elevation of finish grade and extend not less than 18 inches (450 mm) from tree trunk on all sides. For balance of area within drip line perimeter, place drainage fill up to 6 inches (150 mm) below elevation of grade.

Place filter fabric with edges overlapping 6 inches (150 mm) minimum.

Place fill layer of material to finish grade. Do not compact drainage fill. Hand grade to required elevations.

**(C) MEASURE AND PAYMENT.** No measure will be taken for this work. No direct payment will be made. This work is considered incidental to the work being performed, the cost of which shall be considered when preparing bids for work in these areas.

**612 MOBILIZATION**

**612.01 DESCRIPTION**

This work shall consists of preparatory work and operations needed to mobilize for the project. Work includes but is not limited to:

1. Movement to, placement and set-up on project site of personnel, equipment, supplies and accessory items;
2. Establishment of offices, buildings, and other needed project facilities as well as utility work and connections needed for these facilities;
3. Scheduling details, coordination and any other work and expense appropriate that is prior to the start of work under other contract pay items.

This work, however, does not include establishing Chief Engineer’s field facilities, construction fence around work and storage areas, nor preparations for maintaining highway traffic.

Mobilization includes demobilization at completion of the project.

**612.02 MEASURE AND PAYMENT**

The unit of measure will be the job with no actual measure taken.

Payment for Mobilization will be made at the contract lump sum price, subject to allowable limits under this section, which payment will include all operations and expense needed to mobilize, remobilize and demobilize. Lump sum price for Mobilization shall not exceed applicable amounts determined as follows:

Original Contract Total	Maximum Lump Sum
Including Mobilization	For Mobilization
More Than To and Incl.	
\$ 0 \$ 200,000	10% of Contract Total
200,000 1,000,000	\$20,000 plus 7.5% (of Contract Total minus \$200,000)
1,000,000 -----	\$80,000 plus 5% (of Contract Total minus \$1,000,000)

If the lump sum shown in the Pay Item Schedule for any bid for Mobilization exceeds the allowable amount shown in the table above, the District reserves the right to adjust the amount and total bid accordingly when checking bids. Said adjustment will in no way invalidate bids.

Payment for Mobilization will be made in two (2) installments. First payment of 50 % of lump sum will be made following mobilization and initiation of construction work. The second and final payment will be made after 20 % of contract work is complete.

No additional payment will be made for demobilization and re-mobilization due to shutdowns, suspension, partial suspensions or other interruptions in project progression.

When no pay item is listed for Mobilization, no payment will be made; costs shall be reflected and distributed in other contract items.

## **613 PERMANENT BENCH MARK**

### **613.01 DESCRIPTION**

The Contractor shall furnish and install a permanent bench mark to conform with details and at the location shown in the contract documents or as directed by the Chief Engineer.

### **613.02 MATERIALS**

Concrete – 817

Galvanizing – 811.07

Malleable Iron – 815

### **613.03 CONSTRUCTION REQUIREMENTS**

The galvanized pipe casing shall be driven vertically and straight and to the depth as shown on the contract documents. The metal frame and cover shall be a standard meter box cover with a hinged locking lid, or an approved substitute. The Contractor shall furnish the Chief Engineer with a suitable wrench for access to the bench mark proper.

### **613.04 MEASURE AND PAYMENT**

The unit of measure for Permanent Bench Mark will be each. The actual number of Permanent Bench Marks complete in place and accepted will be paid for at the contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work.

## 614 PCC TRAFFIC BARRIERS

### 614.01 PCC MEDIAN AND ROADSIDE BARRIERS

- (A) **DESCRIPTION.** Work consists of the construction of PCC traffic barriers in accordance with these specifications at locations indicated in the contract documents and/or established by the Chief Engineer. The types of barrier will be stipulated in the contract documents. The PCC Median and Curb Barriers may be precast, cast-in-place or slip-form. The construction of various types of barrier shall include the assembly and erection of all component parts and furnishing all materials complete in place.

Necessary transition of the PCC Median and Curb Barriers to sections different from the standard uniform section such as at bridge piers, sign pedestals, bridge end walls, or guardrail terminal sections, shall be accomplished in a smooth and uniform manner as shown in the standard drawings or in the contract documents.

(B) **MATERIALS.**

Concrete – 817, Class B

Reinforcement – 812.02

Epoxy Coated Reinforcement Bars – 812.03

Preformed Joint Filler – 807.01

Anchor Bolts, Rods, Sleeves, Dowels, etc. – 815.01

Compression Seals – 807.06

Epoxy Grout – 806.05(C)

Mastic Joint Sealer – 807.02(B)

Barrier Delineators – 822.13(B)

(C) **CONSTRUCTION REQUIREMENTS.**

- (1) **CAST-IN-PLACE BARRIERS.** When casting in place, the forming may be either the conventional fixed form or slip-form method.

Cast-in-place concrete barriers shall be in accordance with the following:

- (a) **FIXED FORM METHOD.** Forms shall be steel and of such construction that there shall be minimum interference to inspection for grade and alignment. The condition and the stability of the forms shall be such that they will produce a barrier that shall meet the required tolerance of deviations not exceeding 1/4 inch in ten feet in either grade or alignment. Before concrete is placed against the forms, they shall be thoroughly cleaned and coated with form release compound each time they are used.

Concrete shall be mixed in accordance with 501.09 and placed in accordance with 703.08. Concrete shall be vibrated by means of an approved immersion type mechanical vibrator.

Construction or contraction joints shall be constructed every 20 feet except that joints shall match the joints in the roadways, footers and walls where barrier is anchored to the roadway slab or abuts a wall. However, sections of a minimum of 10 feet in length may be constructed if necessary to make use of delivered concrete. Expansion joints shall be placed at the same location as that of the roadway or as directed by the Chief Engineer.

Concrete shall be finished in accordance with 703.19. The top of barrier, when finished, shall show no deviation from grade and alignment in excess of 1/4 inch in 10 feet.

The minimum time required before removal of forms will depend on the temperature at the time of pour and shall be as follows:

Temperature	Hours
Greater than 50°F (10°C)	12
Between 35°F (2°C) and 50°F (10°C)	24
Less than 35°F (2° C)	72

All honeycombed and damaged areas shall be repaired to the satisfaction of the Chief Engineer immediately after the removal of the forms.

- (b) **SLIP-FORM METHOD.** Slip-form equipment shall be approved by the Chief Engineer and include the incorporation of automatic guidance controls to follow line and grade reference. The use of manual control on slip-form equipment is not permitted. Line and grade reference shall consist of taut lines or wire suspended from supports set in the subgrade or adjacent pavement. The references shall be 25 feet intervals on uniform grades and tangent sections. On vertical and horizontal curves, an additional intermediate support shall be set in the field to establish a reference line acceptable to the Chief Engineer. The use of ski or shoe sensors reflecting variations in grade of existing roadway surface will not be permitted.

Concrete shall be mixed in accordance with 501.09. The concrete shall be of such consistency that after extrusion it will maintain the shape of the barrier without support. The surface shall be free of surface pits larger than 3/16 inch in diameter. The concrete shall require no further finishing other than light brushing with water only. Finishing with a brush application of grout will not be permitted.

Whenever a tear occurs during the operation of the slip-form equipment, it shall be repaired immediately. The repair shall be made in accordance with good concrete practices that are acceptable to the Chief Engineer. It will be at the sole discretion of the Chief Engineer as to whether the tear can be repaired or whether the areas will require removal and replacement.

Contraction joints shall be sawed or formed at 20 feet intervals in the barrier and footing. Each joint shall be a minimum of 2 inches in depth and 1/8 inch in width. Expansion joints will be required at the same location as that of the roadway and/or as directed by the Chief Engineer. However, sections of 10 feet

length may be constructed if necessary to make use of delivered concrete. At the terminus of any pour less than 20 feet a bulkhead form shall be placed; and six No. 8 dowels, 2 feet long, shall be placed through the bulkhead. No joint material is required.

The concrete footing may be constructed by the fixed form or the slip-form method. The construction of the footing and the barrier section as a monolithic pour shall not be permitted.

- (2) **PRECAST CONCRETE BARRIERS.** Precast concrete barriers will not be permitted on curves of short radius. They shall be cast in sections having a uniform length of 10 to 12 feet.

The concrete shall be placed, cured and protected in accordance with 703.08 and 703.18. Lifting holes, rings, hooks or other handling devices, as approved by the Chief Engineer, may be inserted in the precast sections. Holes exposed to completed work shall be filled with mortar. Other handling devices shall be removed to the satisfaction of the Chief Engineer.

The supporting concrete base shall be constructed by the conventional fixed form method and shall have joints constructed at 10 feet intervals to coincide with lengths of barriers. The joint shall be constructed by sawing or other methods for the width of the base to a minimum depth of 3 inches. The base section shall be doweled to the barrier section as shown in the contract documents.

Precast barriers shall be placed in such a manner that there will generally be a joint opening of 1/4 inch between sections. To this specified joint opening, a tolerance of 1/8 inch plus or minus will be permitted throughout the plane of the joint.

The ends of each section of barrier shall have an interlocking configuration and/or mechanical locking device to resist lateral movements when in final position.

All surfaces shall have an ordinary finish as specified in 703.19.

**(D) MEASURE.**

The unit of measure for PCC Median Barrier (Cast-In-Place or Precast) and PCC Roadside Barrier will be the linear foot as measured along the top center line of the barrier complete in place. The unit of measure for PCC Median/Curb Barrier (Variable Section) will be the cubic yard. If installation of Barrier Delineators is specified, they will not be measured for payment.

**(E) PAYMENT.**

Payment for each type of barrier will be made at the contract unit price per linear foot or per cubic yard as measured above which payment shall be full compensation for all equipment, labor, materials, such as reinforcement, joint filler, compression seals, epoxy grout, anchorage, and incidentals necessary to complete the various items of work.

No payment will be made for barrier delineators. The cost of delineators will be included in the contract unit price for the barrier.

**614.02 PORTABLE PRECAST PCC BARRIER**

- (A) **DESCRIPTION.** Work consists of furnishing, installing and maintaining temporary precast PCC New Jersey or F Shape (safety shape barriers, including replacing any broken sections, maintaining proper alignment, relocating barriers as shown on the contract plans or as per approved traffic control plans, during the course of the project, and removal from the work site after completion of the project. Work also includes cleaning the barriers as directed.

Barriers shall be either 32 inches in height and 24 inches in width, or 32 inches in height and 18 inches in width for half size as specified in the contract documents. Typical section lengths shall be 12 feet but may be varied to insure portability and proper installation. Portable Precast PCC Barriers shall have built-in connections devices meeting the requirements of NCHRP Report 350, TL3. Where specified on the contract plans, barriers shall be anchored to the concrete bridge deck at no additional cost to the District. Half size barrier shall not be installed unless anchored by approved methods. Barriers shall have drainage slots or be placed so as to permit drainage of the roadway surface.

**(B) MATERIALS.**

Concrete – 817, Class B

Welded Wire Fabric – 812.01 (4 x 4)

Barrier Delineators – 822.13(B)

**(C) MEASURE AND PAYMENT.**

The unit of measure for Portable Precast PCC Barrier will be the linear foot. The length for measurement will be the actual maximum length along the top centerline complete in place. If installation of Barrier Delineators is specified, they will not be measured for payment.

**Install Portable PCC Barrier** – Payment for the delivery and the initial installation of the Barrier in the work zone for the first phase of construction and removal from the job site upon completion of the work will be made at the contract unit price per linear foot, which payment will include all labor materials, tools, equipment and incidentals necessary to complete the work. Barrier stored at the project site prior to the construction start will not be measured under the item for Move Portable PCC Barrier.

**Move Portable PCC Barrier** – Payment for Move Portable PCC Barrier will be made at the contract unit price per linear foot of barrier moved for each phase of construction as specified in the approved traffic control plan or directed by the Chief Engineer. Payment will include all labor, material, tools, equipment and incidentals necessary to complete the work.

No payment will be made for Barrier Delineators. The cost of delineators will be included in the contract unit price for the barrier.

No payment will be made for barrier delineators. The cost of delineators will be included in the contract unit price for the barrier.

## 615 MEMBRANE WATERPROOFING

### 615.01 DESCRIPTION

Membrane waterproofing shall consist of furnishing all materials, labor, tools, and equipment necessary to apply two-ply or three-ply membrane waterproofing at the locations and to the areas shown in the contract documents and/or as specified herein.

### 615.02 MATERIALS

Materials for this work shall conform to 802.05. Asphalt materials, including primers, fabrics, and mop coats shall not be used in conjunction with coal tar materials.

### 615.03 CONSTRUCTION REQUIREMENTS.

(A) **GENERAL.** Membrane waterproofing shall not be applied until all provisions for curing concrete have been complied with and the surfaces have thoroughly dried, reasonably smooth and are free from projections or holes that might puncture the membrane.

The concrete surfaces shall be cleaned of all loose and foreign materials, concrete fins, and dirt, and shall be dry. The Chief Engineer may require the surfaces to be scrubbed with water and a stiff brush, after which the surfaces shall be allowed to become thoroughly dry before application of materials.

Membrane waterproofing shall not be done when the temperature is 35° F or lower, or in damp or wet weather.

The surfaces shall first be painted with a primer, either by spraying or brushing. The amount of the primer coat shall be not less than 1/8 gallon for each square yard of surface. The primer shall be applied so as to give a uniform coating. The primer coat shall be applied 24 hours in advance of applying any mop coats, and shall be allowed to become thoroughly dry before the first mopping is applied. The primer shall not be heated.

Asphalt shall be heated to a temperature between 300°F and 350°F and tar shall be heated to a temperature between 200°F and 250°F, with frequent stirring to avoid local overheating. The heating kettle shall be equipped with thermometers.

Mopping on concrete shall cover the surface so that no gray spots appear. Mopping on fabric shall be sufficiently heavy to completely conceal the weave.

On both vertical and horizontal surfaces, not less than 15 gallons of hot asphalt or hot tar shall be used for each 100 square feet of finished work. The work shall be so regulated that at the end of the day's work, all fabric that is laid shall have received the final mopping of asphalt or tar. Special care shall be taken at all laps to assure a thorough seal.

Strips of fabric of the width required shall be used to eliminate lapping of piles. All end laps shall be at least 12 inches.

Care shall be taken to confine all bituminous materials to the areas to be covered and special care shall be taken to prevent disfigurement of any other parts of the structure by dripping or spreading of the materials.

At the ends of the membrane and at any points where it is punctuated by such appurtenances as drains or pipes, suitable provisions shall be made to prevent water from getting between the waterproofing and the waterproofed surface.

- (B) JOINTS.** Membrane waterproofing shall be three-ply. The first layer or fabric shall be 1 foot wide, the second layer shall be 2 feet wide, and the third layer shall be 3 feet wide. All layers shall be placed symmetrically about the joint.

The surface shall be mopped for the entire width of strip and the first layer of fabric, placed immediately following the mopping, shall be carefully pressed into place to eliminate all air bubbles and obtain close conformity with the surface. The surface of the fabric shall be mopped and, in the same manner, the second and third layers of fabric shall be placed. The entire surface shall then be given a final mopping.

- (C) SURFACES.** In all cases, the waterproofing shall start at the low point on the surface to be waterproofed and proceed upward so that the water will run over and not against or along the laps.

Beginning at the low point on the surface, a section 2 inches wider than half the width of the cotton fabric being used, and for the full length of the surface, shall be mopped with hot asphalt or hot tar. Upon this hot mopping, a half- width of cotton fabric shall be placed and pressed into it to eliminate all air bubbles and obtain close conformity with the surface. The half width of cotton fabric and an adjacent section of the surface 2 inches wider than half the width of the fabric being used shall then be mopped. On this mopping shall be placed a full width of cotton fabric, completely covering the first or half-width strip and pressed into place as before. The second full width strip shall be placed on hot mopping in such a manner that it will lap the second previous or half-width strip by at least 2 inches. Thereafter, full widths of cotton fabric shall be placed on hot mopping in such a manner that each strip shall lap the second previous strip at least 2 inches until the entire surface is covered. All end laps shall be at least 12 inches. The entire surface shall then be given a final mopping of hot asphalt or hot tar.

There shall be no break in the membrane waterproofing at expansion joints. The waterproofing fabric shall be given a slight roll and pressed down in order to allow a small amount of movement.

The completed waterproofing shall be a firmly bonded membrane composed of 2 layers of fabric and 3 moppings of asphalt or tar. Under no circumstances shall 1 layer of fabric touch another layer at any point or touch the surface being waterproofed as each layer of fabric must be covered with a complete mopping of asphalt or tar. Backfilling shall not begin until the final mop coat is thoroughly hardened as directed by the Chief Engineer.

Care shall be taken to prevent injury to the finished membrane. Any damage that may occur shall be repaired by patching as approved by the Chief Engineer. Patches shall extend at least 12 inches beyond the outermost damaged portion and the second ply shall extend at least 3 inches beyond the first.

#### **615.04 MEASURE AND PAYMENT.**

The unit of measure of Membrane Waterproofing will be the square yard. The actual number of square yards of surface area of the concrete, steel, or masonry which is covered by the membrane waterproofing will be paid for at the contract unit price per square yard, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work

## 616 TRAFFIC CONTROL

### 616.01 PERMANENT TYPE WOODEN BARRICADE

(A) **DESCRIPTION.** This work shall consist of the construction of permanent type wooden barricades at the locations other than temporary traffic control zones as indicated in the contract documents and/or as directed by the Chief Engineer, and shall meet the design requirements for Type III barricades in accordance with Section 6F.60 of the “Manual on Uniform Traffic Control Devices “ (MUTCD), latest edition.

(B) **MATERIALS.**

Posts and rails – 822.12(A)

Red and white paints shall be retroreflective.

All assembly hardware shall be hot-dipped galvanized steel meeting the requirements of 811.07. The bolts shall be 1/2 inch in diameter steel carriage bolts equipped with a hexagonal nut. The washer shall be 14-gauge steel, 1-1/2 inch in diameter with 3/4 inch hole.

(C) **CONSTRUCTION REQUIREMENTS.** Excavation for posts shall be roughly circular and shall be of sufficient diameter to permit thorough tamping of the backfill after post placement. Backfill in all cases shall be made with approved embankment materials and shall be thoroughly compacted by tamping to obtain as rigid an installation as possible.

After the alignment of the rails is approved by the Chief Engineer, the nuts shall be tightened and the projecting threads of the bolts shall be burred to prevent removal.

After erection, the rails and posts shall be given 2 coats of paint. The posts shall be painted yellow and the rails shall be painted with alternate diagonal 6 inch stripes of red and white.

All painting shall be done as outlined in 707 using retroreflective coatings.

(D) **MEASURE AND PAYMENT.** The unit of measure for Permanent Type Wooden Barricade will be the linear foot. The actual number of linear feet installed, measured along the face of the top rail will be paid for at the contract unit price per linear foot, which payment will include excavation, erection, backfilling, painting, and all labor, materials, tools, equipment and incidentals necessary to complete the work

### 616.02 CONSTRUCTION LANE CLOSING

(A) **DESCRIPTION.** Work consists of executing the provisions of the Special Provision for Maintenance of Highway Traffic as illustrated by the approved Traffic Control Plan (TCP). The work includes preparation of the TCP, as specified in 104.02(B), in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and these specifications; providing a full time Traffic Safety Officer; providing all additional equipment and personnel, including flaggers when required by the contract documents, as necessary to control traffic as specified or as directed by the Chief Engineer.

**(B) TRAFFIC PERSONNEL.** The Contractor shall provide all necessary personnel for traffic control. Personnel shall be employed in accordance with requirements of Part VI of the MUTCD and these specifications. In addition, the following personnel shall be required:

- (1) TRAFFIC SAFETY OFFICER.** The Contractor shall provide a competent traffic safety officer. The traffic safety officer shall be thoroughly experienced in and qualified for maintenance of traffic safety control work. Prior to commencing work requiring traffic control management, the Contractor shall certify in writing that the proposed Traffic Control Officer, and any designated substitute, has been certified by the American Traffic Safety Services Association (ATSSA). The Contractor shall submit a certificate verifying successful completion of the ATSSA course and a summary of the Traffic Safety Officer's field experience in the operation of work zone traffic control.

Training provided by another agency or firm may be approved by DDOT. The Department will approve training provided by another agency or firm provided that the following minimum requirements are met:

Successful completion of a comparable work zone traffic control course including evidence of passing a written examination on the material presented in the course.

A minimum of one year of documented field experience in work zone traffic control.

The traffic safety officer or an approved substitute, in case of forced absence, is expected to perform the duties on a regular basis and ensure that all traffic maintenance operations are running smoothly at all times by conducting regular inspections along the length of the project, particularly during peak hours.

The traffic safety officer's prime duty shall be the responsibility for the Contractor's maintenance of traffic operations. Duties shall include, but not be limited to, the following:

- (a)** Understand the requirements of the MUTCD and the contract provisions.
- (b)** Be responsible for assuring compliance of the Contractor's maintenance and protection of traffic relative to the requirements of the contract provisions.
- (c)** Be responsible for assuring that all deficiencies are corrected.
- (d)** Be responsible for coordinating maintenance of traffic operations with the Chief Engineer.
- (e)** Be responsible for assuring that all traffic control devices are placed in their proper location and that damaged traffic control devices are promptly replaced.
- (f)** Supervise the installation and removal of all temporary traffic control devices and pavement markings.
- (g)** Be responsible for daily inspection of the work zone traffic control devices. Inspection results shall be recorded in a Traffic Control Device Inspection Log.

The Contractor shall submit the form to be used to the Chief Engineer for approval prior to use.

The Chief Engineer or his designated representative shall inspect the traffic maintenance devices and pavement marking layout on a routine basis. Any deficiencies that are noted will be brought to the Contractor's attention for correction. The Chief Engineer's inspection will not relieve the Contractor of any responsibility for maintaining traffic control items in proper position and condition based on his own inspection.

If any deficiency is not corrected within 24 hours from the documented notice given to the Contractor, a payment deduction will be made from the Contractor's next progress estimate. The deduction will be equal to the daily prorated share of the total price bid for "Construction Lane Closing" or \$500.00 per day, whichever is greater, for each day or portion thereof that the deficiency exists, and will continue until the deficiency is satisfactorily corrected and accepted by the Chief Engineer. The amount of money deducted will be a permanent deduction from the Contract amount and will not be recoverable.

- (2) **FLAGGERS.** When specified in the contract documents or when directed by the Chief Engineer, the Contractor shall provide all necessary flaggers required to properly maintain traffic through the work zone. Flaggers shall have completed flagger training and shall be certified by ATSSA or another agency approved by the District and meet the requirements of Chapter 6E of the MUTCD.
- (C) **MEASURE AND PAYMENT.** No direct measure will be made. The unit of measure will be the job. Payment for Construction Lane Closing will be made at the contract lump sum price, which payment will include preparation and submission of the TCP and provision of a Traffic Safety Officer, flaggers and all additional personnel and equipment necessary to efficiently and safely execute the Traffic Control Plan as approved.

### 616.03 REMOVAL OF LANE MARKINGS

- (A) **CONSTRUCTION REQUIREMENTS.** In areas of the roadway where existing pavement markings conflict with the proposed temporary pavement markings indicated on the approved TCP, the existing markings shall be removed prior to the placement of the temporary markings.

Markings may be ground off or removed by a method acceptable to the Chief Engineer, that will accomplish the complete removal of the conflicting pavement markings. Black paint or spraying with liquid asphalt shall not be acceptable as a method of removal. The work, however, shall be carefully performed so as not to damage or scar the roadway surface. Burning shall not be permitted. Damaged asphalt surfaces shall be repaired at no additional cost to the District. All grind marks on AC pavement shall be painted with emulsified asphalt to reduce the visibility of the line removed. Black non-reflective tape may be used as directed by the Chief Engineer and will be paid under the item for Black Taped Pavement Markings.

During any detouring or lane changes, inappropriate and conflicting pavement markings shall be properly and promptly obliterated prior to placement of detours or new lanes as

specified in the TCP. Marking removal shall be accomplished regardless of time of day or climatic conditions.

Requirements of Section 6F-65, Part VI of the MUTCD are applicable.

- (B) MEASURE AND PAYMENT.** The unit of measure for Removal of Lane Markings will be the square foot, with measurement made on actual width of marking multiplied by length removed.

Payment will be made at the contract unit price per square foot, which payment will include removal operations, any asphalt material and rolling required to return the pavement surface to an acceptable condition, removal of all surplus materials and all labor, tools, materials, equipment and incidentals necessary to complete the work.

#### **616.04 TEMPORARY CONSTRUCTION SIGN SUPPORTS**

- (A) DESCRIPTION.** Work consists of furnishing, assembling and maintaining Temporary Construction Sign Supports required for construction warning and detour signs in or adjacent to the work area, as specified in the TCP. Work also includes removal of the supports from the job site when no longer required.

Sign supports may be either fixed or portable. Fixed supports requiring one or more posts shall be considered as one temporary support. Replacement posts, due to damage or relocation, shall not be counted. For fixed supports, work also includes excavation and/or augering, including backfilling and compaction, to firmly set the posts and eventual removal and restoration of the site. Posts shall be set plumb.

Portable supports shall be manufactured sign supports and shall be stabilized and ballasted according to the manufacturer's direction.

If barricades are approved for use as sign supports, payment will be made at the contract unit price for the type of barricade used.

All construction sign supports shall be in accordance with Part VI of the MUTCD.

- (B) MEASURE AND PAYMENT.** The unit of measure for Temporary Construction Sign Supports will be each. The total shall be the maximum number required and installed according to the approved TCP for any one phase of construction. Fixed sign supports that remain in place according to the approved TCP for succeeding phases of construction will not be re-measured for payment.

Payment will be made at the contract price per each. This payment will include furnishing (including sand bags), assembling, maintaining (including replacement of damaged parts of units at no additional cost to the District) and removing all Temporary Construction Sign Supports required.

#### **616.05 CONSTRUCTION WARNING AND DETOUR SIGNS**

- (A) DESCRIPTION.** Work consists of furnishing, assembling and maintaining construction warning and detour signs as specified in the Traffic Control Plan (TCP) or as directed by the Chief Engineer. Work also includes the removal of the signs from the job site when no longer required.

All construction warning and detour signs shall be in accordance with the requirements of Chapter 6F, Part VI of the MUTCD.

When not in use, signs shall either be removed or completely covered. Covers shall be of an opaque material; burlap or black plastic shall not be used.

Where signs are mounted on light standards, traffic signal supports, etc., work includes furnishing mounting bands or clamps, including all installation hardware.

**(B) MATERIAL.**

1. Fluorescent Orange Sheeting, Wide Angle Prismatic Lens – as per ASTM D4956 and 824.02
2. High Intensity Sheeting, Type III – as per ASTM D4956 and 824.02

**(C) MEASURE AND PAYMENT.** The unit of measure for Construction Warning and Detour Signs will be the square foot. The total shall be the maximum number of square feet required and installed according to the approved TCP for any one phase of construction. Construction Warning and Detour Signs that remain in place according to the approved TCP for succeeding phases of construction will not be re-measured for payment.

Payment for Construction Warning and Detour Signs will be made at the contract unit price per square foot, which payment will include furnishing, assembling, maintaining (including replacement of damaged signs at no additional cost to the District) and removing all required Construction Warning and Detour Signs from the project when no longer required.

**616.06 REFLECTORIZED TRAFFIC CONES**

**(A) DESCRIPTION.** Work consists of furnishing and maintaining traffic cones at the job site. Traffic cones shall be used for short duration traffic channelizations such as installing signs, establishing lane closure, removing or installing pavement markings and installing raised markers. Work also includes removal of the cones from the job site when no longer required.

The retroreflectorized band on traffic cones shall be of high intensity retroreflective sheeting material. Cones shall be a minimum of 28 inches in height.

**(B) APPLICATION.** Cones shall be used in accordance with requirements of Section 6F-56, Part VI of the MUTCD.

**(C) MEASURE AND PAYMENT.** The unit of measure for Reflectorized Traffic Cones will be each. The total shall be the maximum number required and furnished for any one phase of construction.

Payment will be made at the contract unit price per each, which payment will include furnishing, maintaining (including replacing damaged units at no additional cost to the District) and removing all traffic cones when no longer required.

**616.07 STEADY BURNING AMBER LIGHTS, TYPE “C”, AND FLASHING AMBER LIGHTS, TYPE “B’**

- (A) **DESCRIPTION.** Work consists of furnishing, placing, and maintaining warning lights on the Portable PCC Barriers and when required by the Chief Engineer. Warning lights shall be in conformance with Part VI of the MUTCD. Work also includes removal of the lights from the job site when no longer required.

Lights shall include hardware necessary to attach lights to traffic control devices, including barriers and traffic drums, that may be used to delineate traffic lanes.

Steady burning lights shall be used to delineate the travel way only if specified on the TCP or at the direction of the Chief Engineer. Flashing lights shall be mounted on advance warning signs as indicated on the TCP.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Steady Burning Amber Lights, Type C and Flashing Amber Lights, Type B, shall be each. The total measure will be the maximum number required for any one phase of construction. Steady Burning Amber Lights, Type C and Flashing Amber Lights, Type B, that remain in place according to the approved TCP for succeeding phases of construction will not be re-measured for payment.

Payment for these items will be at the contract unit price per each, which payment will include furnishing, placing, maintaining (including replacing damaged units at no additional cost to the District) and removal of all warning lights as specified.

**616.08 ELECTRONICALLY ILLUMINATED TRAFFIC DEVICES (ARROW PANEL)**

- (A) **DESCRIPTION.** Work consists of furnishing, maintaining and relocating Arrow Panels required to channel traffic away from or through traffic control zone as shown on the TCP or as directed by the Chief Engineer. Work also includes removal of the arrow panels from the job site when no longer required. Arrow Panels shall be in conformance with Section 6F-53 Part VI of the MUTCD.

- (B) **OPERATIONAL REQUIREMENTS.** The electronically illuminated traffic control device shall be a Type C Arrow Panel and shall operate as indicated in Figure 6F-3, Part VI of the MUTCD. The size shall be a minimum of 48 inches high and 96 inches long, and shall be finished in with non-reflective black enamel. There shall be a minimum of 15 No. 44121, PART 46, 12 volt amber lamps. The lamp configuration shall have an arrowhead pointing in each lateral direction at each end of the panel, with a minimum of 5 lamps forming the arrow bar (arrow tail). Each lamp shall be provided with a visor and the lamps, when illuminated, shall be visible on a clear, cloudless day, for a minimum distance of 1 mile. The chevron type devices shall only be used in the sequential mode.

The lamps shall be activated by a switch on a control panel and shall be controlled by electronic circuitry to provide 5 selectable modes of operation as follows:

- |              |   |
|--------------|---|
| Pass Left –  | Sequencing of lighted arrowhead to the left.  |
|              | Sequencing of lighted chevron to the left.    |
| Pass Right – | Sequencing of lighted arrowhead to the right. |

	Sequencing of lighted chevron to the right.
Pass Right and Left –	Lighted arrowheads flashing right and left simultaneously.
	When arrow panels are in transit to and from a job site, the two outside top and bottom lamps on the panel shall flash on and off simultaneously.

The electronic circuitry shall provide 25 and 40 completed operating cycles of the sign per minute in each of the modes specified above.

A switch controlled changeable dimming device shall be provided on the control panel that will reduce the voltage on the lamps a maximum of fifty (50) percent for nighttime use.

Electrical energy for operating the arrow panel shall be obtained from a noiseless device or source such as a solar-powered or battery-powered source. Alternative noiseless power sources may be used upon prior approval of the Chief Engineer. The source used shall be capable of operating the arrow panel in the manner heretofore specified. The use of gasoline-powered or diesel-powered motors or generators as energy sources for this work will not be permitted.

Arrow Panels mounted on the cab of a truck shall be mounted to provide a minimum of 7 feet between the bottom of the sign and the roadway.

Arrow Panels mounted on a trailer, or on other than the cab of a truck, shall be mounted to provide a minimum of 8 feet between the bottom of the sign and the roadway.

If the Chief Engineer gives advance written approval, a similar alternate flashing arrow sign configuration may be used.

If arrow panels, or the vehicle on which said signs are mounted, are damaged from any cause during the progress of the work, the Contractor shall immediately repair or replace said signs to their original condition and location. Payment for this work will be in accordance with 616.20.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Arrow Panels will be each or will be per hour as specified in the contract documents. The total for each arrow panel will be the maximum number required and used for any one phase of construction. The total per hour will be the actual number of hours the arrow panel is in the operation mode at the location specified for any one phase of construction in the approved TCP or by the Chief Engineer.

Payment will be made at the contract unit price per each, which payment will include furnishing, relocating as required, maintaining and removing all units as specified.

### 616.09 WORK ZONE BARRICADES

- (A) **DESCRIPTION.** Work consists of furnishing, relocating and maintaining Type I, II and III PVC Barricades (Polyvinyl-chloride) at the job site. Barricades shall be in accordance with Section 6F.60, Part VI of the MUTCD. The retroreflective area of the barricades

shall be Type III reflective sheeting specifically designed for barricade use and performance. The barricades shall be placed in areas delineated in the contract documents and/or as directed. Each barricade shall be ballasted with deformable weights such as sand bags placed on the lowest section of frames and not on a retroreflective rail. When specified in the contract documents, barricades shall be equipped with Type “B” or Type “C” lights, meeting requirements of 616.07. Work also includes removal of the barricades from the job site when no longer required.

- (B) **APPLICATION.** Type I, II and III PVC barricades shall be used in accordance with Section 6F.60, Part VI of the MUTCD.
- (C) **MEASURE AND PAYMENT.** The unit of measure for Type I, II and III PVC Barricade will be each. The total number will be the maximum number of each type required and used for any one phase of construction.

Payment will be made at the contract unit price per each, which payment will include furnishing (including ballast), assembling, maintaining (at no additional cost to the District) and removal of the barricades required.

Measure and payment for Type “B” or Type “C” lights affixed to Type I, II and III barricades will be made in accordance with 616.07(B).

#### 616.10 TRAFFIC DRUMS

- (A) **DESCRIPTION.** Work consists of furnishing, maintaining and relocating Traffic Drums as required during the duration of the project. Drums shall be in accordance with Section 6F.59, Part VI of the MUTCD and shall be made of high impact low density polyethylene or of other approved material and have a smooth sealed outer surface. Drums shall be largely cylindrical in shape with a sufficient number of flat surfaces to prevent rolling. The retroreflective surface of the drums shall be Type III reflective sheeting material specifically designed for drum use and performance. When specified in the contract documents, drums shall be equipped with a Type “B” or Type “C” light. Work also includes removal of the drum from the job site when no longer required.
- (B) **APPLICATION.** Traffic drums shall be used in accordance with Section 6F.59 Part VI of the MUTCD.
- (C) **MEASURE AND PAYMENT.** The unit of measure for TRAFFIC DRUMS will be each. The total number will be the maximum number required and used for any one phase of construction.

Payment will be made at the contract unit price per each, which payment will include furnishing, maintaining and relocating as required, and removal of the traffic drum from the project site when no longer required.

Measure and payment for Type “B” or Type “C” lights affixed to drums will be made in accordance with 616.07(B).

#### 616.11 REFLECTIVE MARKERS AND DELINEATORS

- (A) **DESCRIPTION.** Work consists of furnishing and installing Raised Reflective Pavement Markers of the snow-plowable and surface mount types as lane and edge line delineation

where shown in the contract documents. This item shall also consist of furnishing and installing Reflective Barrier Delineators and Reflective Guardrail Delineators.

**(B) MATERIAL.** Casting, Reflector, Primer and Adhesive – as per 822.13.

**(C) CONSTRUCTION REQUIREMENTS.**

**(1) SNOW-PLOWABLE RAISED REFLECTIVE PAVEMENT MARKERS (RPM).** Markers shall be installed in the locations indicated in the contract documents and/or as directed by the Chief Engineer. The casting, (as per 822.13(A)(1)), shall fit into a groove(s) cut in the road surface. The prismatic retroreflector, (as per 822.13(A)(2)), shall be approximately even with the road surface, and casting and reflector shall be installed at a height above the roadway surface not to exceed 0.25 inches. The Snow-Plowable Raised Reflective Pavement Markers shall be installed according to part VI, MUTCD, Section 3B.13 for RPMs Supplementing other pavement markings and Section 3B.14 for RPMs substituting for pavement markings.

Markers along lane lines shall be installed centered between skip lines. Markers along edge lines shall be installed along the travel side of the edge line. Where double white markers are indicated, the markers shall be installed laterally to the right and left of the line and 2 inches between line and marker.

On ramp roadways and sharp radius horizontal curves, care is to be exercised so that the markers are installed at right angles to the direction of headlight beams. The color of the pavement markers shall be white along the right side of all traveled roadways and along the lane lines, and yellow along the left side of all traveled roadways, unless otherwise indicated or directed.

The snow-plowable raised pavement markers shall be install by saw cutting two parallel grooves into the pavement to a depth and to the dimensions recommended by the manufacturer. The grooves shall be parallel to the adjacent pavement markings. The grooves shall be cut with saw blades having a diameter to match the curvature of the steel casting bottom and the keels. The keel surfaces shall be free from scale, dirt, oil, grease or any other contaminant that might reduce bonding. The retro-reflective lenses and other exposed surfaces of the marker shall be free of any dirt, debris and adhesive.

The RPM casting keels shall be bonded in the saw-cut grooves in the manner recommended by the manufacturer of the marker. The ends of the casting shall be installed flush with the pavement surface. The marker shall be protected against impact until the adhesive has hardened to the point where the marker will not be dislodged by traffic, but in no case less than one hour. Any marker dislodged before completion of the contract shall be replaced by the Contractor at no cost to the District. The ambient temperature at the time of installation of the snow-plowable markers shall be 50 degrees F or higher.

The markers shall be placed so that in all cases the plane of the reflective surface shall be at right angles to the direction of traffic. No pavement marker shall be placed over longitudinal or transverse pavement joints.

**(2) SURFACE MOUNT RAISED PAVEMENT MARKERS**

Surface Mount Raised Reflective Pavement Markers shall be installed in the locations indicated in the contract documents and/or as directed by the Chief Engineer. The Surface Mount Raised Reflective Pavement Markers shall be installed according to Part VI, MUTCD Section 3B.13 for RPMs Supplementing other pavement markings and Section 3B.14 for RPMs substituting for pavement markings .

Markers along lane lines shall be installed centered between skip lines. Markers along edge lines shall be installed along the travel side of the edge line. Where double white markers are indicated, the markers shall be installed laterally to the right and left of the line and 2 inches between line and marker.

On ramp roadways and sharp radius horizontal curves, care is to be exercised so that the markers are installed at right angles to the direction of headlight beams. The color of the pavement markers shall be white along the right side of all traveled roadways and along the lane lines, and yellow along the left side of all traveled roadways, unless otherwise indicated or directed.

The surface mount raised reflective pavement markers shall be bonded to the pavement surface in accordance with the manufacturer's recommendations. The bonding material shall be in accordance with 822.13(3). An approved alternative bonding material shall be used in lieu of epoxy on asphalt concrete pavement.

The marker shall be protected against impact until the adhesive has hardened to the point where the marker will not be dislodged by traffic, but in no case less than one hour. Any marker dislodged before completion of the contract shall be replaced by the Contractor at no cost to the District.

The markers shall be placed so that in all cases the plane of the reflective surface shall be at right angles to the direction of traffic. No pavement marker shall be placed over longitudinal or transverse pavement joints.

- (3) REFLECTIVE BARRIER DELINEATORS.** Reflective Barrier Delineators may be installed on the face of permanent barriers or on the top of temporary barriers as specified in the contract documents or as directed. The permanent barrier delineator shall be mounted 24 inches above the roadway surface, with the retroreflective surface of the reflector at 90 degrees to the pavement surface and normal to the direction of traffic, and the longer axis vertical. The temporary barrier delineators shall be install on the top of the barrier at intervals specified in the contract documents or as directed.

The delineator shall be attached to the barrier as recommended by the manufacturer. If a primer is required for preparing the barrier surface prior to attaching the delineator, the primer shall be that recommended by the manufacturer. The delineator shall be held in place for the time recommended by the manufacturer to provide the sufficient bond to prevent slippage of the delineator from the designated location on the barrier.

- (4) REFLECTIVE GUARDRAIL DELINEATORS.** The delineator shall be installed on the guardrail so as to be completely enclosed by, and flush with, the guardrail. The delineator shall be attached to the guardrail by the means recommended by the

manufacturer. The retroreflective surface of the delineator reflector shall be normal to the direction of traffic, with the longer axis vertical.

- (D) **MEASURE AND PAYMENT.** The unit of measure for Snow-Plowable and Surface Mount Raised Reflective Pavement Markers, and Temporary Barrier Delineators will be each. No measure will be taken for either Permanent Reflective Barrier Delineators or Permanent Reflective Guardrail Delineators.

Payment for Snow-Plowable and Surface Mount Raised Reflective Pavement Markers, and Temporary Barrier Delineators will be made at the contract unit price per each, which payment will include furnishing complete delineators and markers and their installation and all other materials, labor, tools, and equipment necessary to complete the work.

No payment will be made for either Reflective Barrier Delineators or Reflective Guardrail Delineators. The cost of furnishing and installing the delineators will be included in the contract price for the respective barrier or guardrail pay item.

#### 616.12 THERMOPLASTIC PAVEMENT MARKINGS

- (A) **DESCRIPTION.** Work consists of furnishing and applying lead-free permanent thermoplastic pavement markings on finished asphalt concrete pavement as detailed in the contract documents and specified by the Chief Engineer. Pavement markings shall be installed according to Chapter 3B of the MUTCD. Details of pavement word and symbol markings shall meet the requirements of Section 3B.19 of the Manual on Uniform Traffic Control Devices (MUTCD). The Contractor shall furnish all supervision, labor, supplies, and equipment necessary for the proper conduct and completion of the work. The Contractor shall also provide all traffic control necessary to maintain and protect traffic according to the MUTCD and the contract documents.

- (B) **MATERIALS.** Materials shall meet the requirement of 821.02.

- (C) **CONSTRUCTION REQUIREMENTS.** The Contractor shall ensure that the pavement surface is dry and free of oil, dirt, grease and any other contaminants prior to the application of the pavement markings. The thermoplastic pavement markings shall be applied by an extrusion method prescribed by the manufacturer. Pans and aprons to regulate the width of lines shall not be permitted. The equipment, including the extrusion die, shall be manufactured and calibrated to maintain the thermoplastic pavement marking material at its proper extrusion, temperature and density, resulting in a pavement marking of the width specified in the contract documents. The thermoplastic pavement markings shall have a set thickness range of 80 to 90 mils. The compound shall be extruded at a temperature of 400 to 425°F, ambient air temperature shall be 45°F and rising, and the ground temperature shall be 55°F or higher.

The thermoplastic pavement markings shall be set with straight, clean-cut, parallel edges. The width of the line shall not vary more than ¼ inch, and the alignment shall not vary more than ¾ inch in any 40 ft. section of roadway.

Retroreflectorization shall be accomplished by an immediate dispensing of reflective beads from a bead dispenser attached to the applicator at the rate of 7 pounds per 100 ft. Reflective beads shall be applied uniformly in the prescribed quantity so that the completed pavement marking will register 250 mcd/m<sup>2</sup>/lux for white pavement markings,

and 150 mcd/m<sup>2</sup>/lux for yellow pavement markings on a 30m geometry retroreflectometer. The retroreflectometer shall be supplied by the Contractor with certification of the calibration by the manufacturer. The pavement markings retroreflectivity shall be determined and comply with the requirements listed under this item within 30 days after the application under the supervision of the Chief Engineer.

- (D) **DRYING TIME.** Drying time necessary for the stripe to become permanently fixed and to set so that normal traffic will not create distortion shall not appreciably exceed the straight line curve established by the values of 2 minutes at 50°F, and 15 minutes at 90°F ambient air temperature and 70 percent relative humidity.
- (E) **COLOR.** White – Federal Standard Color No.595-17886  
Yellow – Federal Standard Color No. 595-13538
- (F) **MEASURE AND PAYMENT.** The unit of measure of marking stripe will be the linear foot. Measurement for word and symbol markings will be per each.

Payment will be made at the contract unit price per linear foot for each size of marking stripe complete in place and per each for word and symbol markings. The payment will include conditioning of pavement surfaces, sampling and testing, all extruding and installation operations, including any removal and reinstallation of faulty or otherwise unacceptable marking stripes, necessary protection of marking stripe, and all labor, tools, materials, equipment and incidentals necessary to complete the work.

### 616.13 PAINTED LANE MARKINGS

- (A) **DESCRIPTION.** Work consists of furnishing and applying the lane markings as specified in the contract documents for non-toxic water-borne traffic paint, epoxy markings or polyester marking material for white and yellow pavement markings in the lengths and widths, symbols and letters as specified in the contract documents or as directed by the Chief Engineer. The traffic paint, epoxy marking material and polyester marking material shall be suitable for application on asphalt concrete or PCC surfaces.
- (B) **MATERIALS.** Materials shall meet the following requirements:
- Traffic Paint – as per 821.04; Glass Beads as per 821.10(C)  
Epoxy – as per 821.03; Glass Beads as per 821.10(B)  
Polyester – as per 821.03; Glass Beads as per 821.10(B)
- (C) **CONSTRUCTION REQUIREMENTS.** The specified marking material shall be applied on a clean and dry surface at the rate recommended by the manufacturer. If no rate is specified, the paint shall be applied at the rate indicated in 821.

Stripes shall be sharp, clean-cut and well-defined lines within the following tolerances:

- (1) The longitudinal accumulative offset within a 40 foot length of lane line shall be not more than  $\pm 1$  inch.
- (2) The line width shall not vary more than  $\pm 1/4$  inch.

- (D) **MEASURE AND PAYMENT.** The unit of measure for Painted Lane Markings for lane lines will be the linear foot. The unit of measure for Painted Lane Markings for symbols and letters will be each. Payment will be made at the contract unit price per linear foot or each as specified, which payment will include furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

#### 616.14 PREFORMED PAVEMENT MARKINGS

- (A) **DESCRIPTION.** Work consists of furnishing and installing permanent or temporary preformed pavement markings as specified in the contract documents. The permanent or temporary pavement markings will be used to delineate traffic lanes, gores, edge lines, crosswalks, stop lines, letters and symbols as indicated in the contract documents or as directed by the Chief Engineer. Work also includes repairing lengths and sections of words or symbols damaged or misaligned during application at no additional cost to the District.

- (B) **MATERIALS.** Preformed pavement markings shall meet the requirements of 821 for the type of markings indicated in the contract documents and the following:

1. Permanent Preformed Line Striping – 821.06
2. Permanent Preformed Patterned Line Striping – 821.07
3. Permanent Preformed Line Striping – Heat Applied – 821.08
4. Removable Preformed Line Striping – 821.09

Removable Preformed Line Striping shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

- (C) **CONSTRUCTION REQUIREMENTS.** The pavement surface to which the preformed pavement markings are to be applied shall be clean of all dirt and debris to permit proper adhesion of the preformed markings to the pavement surface. The manufacturer's recommendations shall be followed for application of markings, application of primers and temperature requirements.
- (D) **MEASURE AND PAYMENT.** The unit of measure for Preformed Pavement Markings lines of specified width will be the linear foot. The unit of measure for Preformed Pavement Markings symbols and letters will be each. Payment will be made at the contract unit price per linear foot or per each as specified, which payment will include all materials and all labor, tools, equipment and incidentals necessary to complete the work. The removal and disposal of Removable Preformed Line Striping will be paid under 616.03.

#### 616.15 TRUCK MOUNTED ATTENUATOR

- (A) **DESCRIPTION.** Work consists of furnishing, installing, maintaining and moving a Truck Mounted Attenuator (TMA) at the project site meeting the requirements of the National Cooperative Highway Research Program (NCHRP) Report 350 for Test Levels 2 and 3 as specified in the contract documents. The Contractor shall provide a copy of the Federal Highway Administration (FHWA) acceptance letter documenting that the specific TMA used on the project site conforms to the requirements of NCHRP Report 350.

- (B) **TMA REQUIREMENTS.** The truck mounted attenuator shall be capable of being mounted on the rear of a truck provided by the Contractor. The TMA support truck shall have a gross vehicle weight (GVW) range recommended by the attenuator manufacturer, and shall be equipped with the standard trailer lighting systems as required by the Federal Motor Vehicle Safety Standards (FMVSS) 108. The TMA shall be installed and operated according to the manufacturer's recommendations. The supporting documentation for the truck weight and the TMA manufacturer's recommendations shall be supplied by the Contractor to the Chief Engineer prior to the TMA set up in the work zone. Weight may be added to the support truck to achieve the manufacturer's recommended GVW, and the support truck shall be installed with the transmission set in second gear or park for automatic transmissions.

The TMA shall be equipped with a minimum of one high intensity amber strobe light in operation while the TMA is installed in the work zone. An electronic arrow panel operated in the caution mode may be substituted for the high intensity strobe light at the direction of the Chief Engineer.

The TMA shall also be equipped at the rear panel with a chevron object marker consisting of orange and black stripes 6 inches wide sloped at a 45 degrees angle from the top of the panel in both directions. The orange stripes shall be fabricated from fluorescent orange prismatic lens sheeting conforming to 824.02. The chevron shall cover a minimum of 75 percent of the rear panel area, and shall be visible to traffic at all times.

The TMA shall be not less than 72 inches wide and not more than 96 inches wide. The color of the TMA shall be yellow or orange, and conspicuity markings shall be provided.

The TMA shall be equipped with a hydraulic system for tilting to a vertical position on the truck when not in use. Hand operated jacks with steel swivel casters shall be provided if necessary to facilitate installation and removal of the TMA from the support truck.

The support truck shall not be used for other purposes while the truck-mounted attenuator is being used to protect the work zone.

- (C) **CONSTRUCTION REQUIREMENTS.** The truck mounted attenuator shall be kept in operating condition at all times during construction. Should the TMA(s) become damaged from any cause during work zone protection so that the TMA ceases to function as designed on the project site, the work protected by the TMA shall be suspended until, the Contractor immediately repairs or replaces the parts as in accordance with 616.20. All other costs related to the maintenance of this unit shall be reflected in the bid price for this item. At the completion of the project, the unit shall remain the property of the Contractor and shall be removed from the project site.
- (D) **MEASURE AND PAYMENT.** The unit of measure for Truck Mounted Attenuator shall be per each unit or for each hour per unit furnished, maintained and installed at the project work zone. The unit of measure will be specified in the contract documents.

Payment for Truck Mounted Attenuator shall be at the contract unit price per each or for each hour per unit as specified in the contract documents, and shall include furnishing, installing on a suitable vehicle, maintenance, repair and disposal of the unit and all materials, parts, labor, tools and incidentals needed to perform the required work.

### 616.16 CONSTRUCTION ZONE ATTENUATOR

- (A) **GENERAL.** Work under this item consists of furnishing, installing and maintaining, in accordance with the manufacturer's specifications for the speed (MPH) specified in the contract documents, re-directive stationary crash cushion systems meeting the requirements of NCHRP Report 350, Test Level 3, for temporary protection during construction as shown on the approved TCP or as directed by the Chief Engineer. The Contractor shall furnish the manufacturer's certification of the NCHRP Report 350 letter of approval from FHWA for the type of attenuator proposed for the project prior to the installation. All elements and materials of the system shall be the same as those tested for the FHWA certification. Work also includes relocating the attenuators as work progresses and removal of the attenuators from the project site when no longer required for protection.

A Type 3 hazard marker shall be installed on the nose of the unit.

As part of this work, the Contractor shall have available for replacement sufficient parts, as recommended by the manufacturer, to repair the unit if needed. Replacement parts will be paid in accordance with 616.20.

- (B) **MATERIALS.** All materials for this work shall be as specified by the manufacturer.

(C) **ATTENUATOR ELEMENTS**

Energy Absorbing Cartridges – Frangible or collapsible weather resistant cartridges.

Diaphragms – Galvanized steel frames containing the energy absorbing cartridges.

Fender Panels – Galvanized steel thrie beam or Quad-beam™ guardrail sections bolted at their front ends to each side of the diaphragms.

Nose Wrap – Yellow high density polyethylene molded nose cover matching thrie beam or Quad-beam™.

Transition Panels – The transition panels shall be supplied with the construction zone attenuator and suitable for connection to the walls, parapets, barrier or guardrail existing in the work zone.

Hazard Marker – A hazard marker, meeting the requirements of Section 3C, Type 3, of the MUTCD, shall be attached to the nose of each attenuator. The hazard marker shall face oncoming traffic.

- (D) **APPLICATIONS** – Construction Zone Attenuators shall be required at approach ends of portable PCC safety barriers and other fixed objects in the work zone identified in the contract documents or by the Chief Engineer.

- (E) **CONSTRUCTION REQUIREMENTS** – Installation of the attenuators shall be accomplished by the Contractor with experienced workers in accordance with the recommendations of the manufacturer of the crash cushion system for the work zone. The Contractor shall ensure that the anchorage for the crash cushion system can be installed according to the manufacturer's directions. Grading and excavation to make the anchorage area suitable for the installation will be paid under the appropriate contract items for the work.

- (F) **SHOP DRAWINGS** – Shop Drawing for shall be submitted and approved for the crash cushion system prior to installation.
- (G) **MEASURE AND PAYMENT** – The unit of measure for Construction Zone Attenuator for the size specified in the contract documents will be each. The number will be the maximum number required for any one phase of construction.

Payment for Construction Zone Attenuator will be made at the contract until price per each, which payment will include furnishing, placing, relocating and removing when no longer required of the attenuator, as measured above. The payment shall also include labor for replacing parts and all labor, materials, including appurtenances and hazard markers, tools, equipment and incidentals needed to complete the work as specified herein.

#### 616.17 SAND-FILLED IMPACT ATTENUATOR MODULES

- (A) **GENERAL.** Work consists of furnishing, installing, relocating as required, maintaining and removing temporary attenuators of the frangible sand-filled inertial module type, to be placed at each traffic-facing end of the portable concrete barriers and at other locations as shown on the Traffic Control Plan and/or as directed.

Also included as part of this work shall be furnishing and installing hazard markers, meeting requirements below. One (1) hazard marker shall be attached to the lead module of each installation. The marker shall face oncoming traffic.

- (B) **MATERIALS.** Each module shall consist of cylinder, core, lid and sand.
- (1) Cylinders, lids and cores shall be of an approved type. Cylinders shall be yellow in color.
  - (2) Sand shall conform to 803.01, dried to contain not more than one percent (1%) moisture by weight, and contain an antifreeze element in proportions recommended by the manufacturer.
  - (3) Hazard Markers shall meet requirements of MUTCD Section 3C, Type 3.
- (C) **FIELD INSTALLATION.** Assembly and installation of inertial modules shall be in accordance with the recommendations of the manufacturer for the speed (MPH) indicated in the contract documents.

- (D) **MEASURE AND PAYMENT.** Unit of measure for Sand Filled Impact Attenuator Module will be per each module. The total will be the maximum number in use at any one time. Payment will be made at the contract unit price for each module and include all labor, equipment, tools and incidentals to complete the work.

No measure or payment will be made for hazard markers. Furnishing and installing hazard markers will be considered as incidental part of the work under this item.

#### 616.18 PORTABLE CHANGEABLE MESSAGE SIGNS

- (A) **GENERAL** – Work under this item consists of furnishing, locating, operating and maintaining self-contained, trailer-mounted, changeable message signs where shown in

the contract documents or as directed by the Chief Engineer. The changeable message signs are to be used for motorist advisory information.

- (B) **MECHANICAL AND OPERATIONAL REQUIREMENTS.** Changeable message signs shall be capable of displaying messages visible from distances of ½ mile under ideal day and night conditions and legible at distances of 900 feet under all weather conditions. A changeable message sign unit shall be mounted on a two-wheeled trailer. The trailer-mounted changeable message sign units shall be structurally adequate to withstand sustained freeway travel speeds of 55 miles per hour with the sign panels in the travel position. The sign panels and the trailers shall be within legal height and width limits, and meet all State and Federal requirements for towed units, when in the travel position. The complete message sign units shall be designed to operate in the ambient temperature range of -31 to 158 °F. When in operation, the units shall be capable of withstanding wind gusts up to 80 miles per hour with all stabilizing devices in place. The units shall not be affected by mobile radio transmissions. All controls shall be located in lockable enclosures, which shall also be weather and shock resistant. A changeable message sign shall consist of the following:

1. **Sign Panel Assembly.** The sign panel assembly shall be of aluminum or stainless steel construction. The sign panel shall consist of three lines of individually changeable orange characters on a black background that are at a wavelength of 590 nanometers. Each line shall be capable of displaying eight characters equally spaced a minimum of 3 inches apart. Each character shall be a minimum of 1 foot-5 inch in height and 1 foot in width. Each character shall be made up of a matrix of bulbs or the following:

(1) A cluster of 35 LED lamp pixels that have a minimum of four LEDs and maximum of six LEDs per pixel, or (2) A full LED matrix character board.

The lamps for a bulb matrix sign shall be rugged, high performance, bayonet, or screw base units. Each lamp shall be a minimum of 20 watts with a life expectancy of at least 8,000 hours. The lamps shall have a minimum light output to meet visibility requirements. All wiring shall be suitable for outdoor use. Each connector point of the wiring harnesses shall be properly marked. The sign panel shall be covered for increased legibility of the sign messages. A bulb matrix sign shall be covered by a sun screen which has fixed horizontal black louvers tilted at 15 to 20 degrees to the horizontal. An LED sign shall be covered with a clear polycarbonate ultraviolet inhibited material to prevent fading.

2. **Controller.** The controller shall be a fully self-contained, compact, solid state, modularized unit with at least 199 pre-programmed messages and with additional capability for storing an additional 199 user generated messages. The unit shall be furnished with the dual capability of message generation at the unit by an integral or plug-in type keyboard system, or by remote control by a digital cellular phone. The controller display shall show a miniaturized version of the message being displayed, or to be displayed, on the sign panel. For security purposes, password coding or key entry access shall be provided to lockout the keyboard. No message shall be displayed unless approved. The antenna for cellular phone reception shall be mounted on top of the sign panel assembly to prevent theft or tampering. The controller shall be designed so that it can accept a pre-programmed default message

or indicator. In the event of power failure, the pre-programmed default message or indicator shall automatically be displayed and remain until such time that repairs can be made, or a minimum of 12 nighttime viewing hours. The default message or indicator can be a single or double flashing or pulsating light (i.e. any warning system that will indicate that the unit is on but not functioning properly). A diesel and battery powered unit shall be equipped with a photocell to reduce the lamp intensity at night thereby eliminating glare to the motorist. A designated representative of the Contractor, familiar with the operation and programming of the unit, shall be available on the Project.

3. **Power Supply.** A changeable message sign shall be battery powered having the capability of operating alternately on 120-volt AC commercial electrical service. The power supply shall conform to the following:

The battery-powered changeable message sign shall consist of banks of batteries recharged by a solar panel array. The number and size of the battery banks and solar panel array shall be sufficient to operate the sign panel for a period of 18 days without the array being exposed to sunlight. The solar panel array shall be capable of recharging the battery banks at a rate of four hours of sun for one 24-hour period of sign usage. The battery-powered unit shall incorporate an automatic intensity control feature to keep the LED lamp matrix intensity constant with a reduction in battery voltage. The battery-powered unit shall be designed to also accept recharging from an internal or external diesel engine driven alternator power supply should there be a lack of proper sunlight. A diesel generator shall be available on the site to charge the batteries in the event the batteries become sufficiently discharged, thereby making the changeable message sign non-functional.

4. **Structural Support System.** The structural support system shall be designed to allow for the sign panel assembly, controller, and power supply to be assembled into a unit that is easily mountable on a trailer. The structural system shall support the sign panel assembly at the proper height and orientation required for visibility, as indicated in Part VI of the MUTCD.

The structural support system shall provide adequate support to allow for complete sign operation, including raising and lowering the sign panel at sustained wind speeds of 30 miles per hour. The raising and lowering mechanism can be either motor-driven or manually operated. If motor-driven, a manual back-up shall be provided in case of electrical failures.

The trailer and sign support system shall be painted safety orange.

- (C) **MEASURE AND PAYMENT** – The unit of measure for Portable Changeable Message Sign will be per each sign delivered to the job site and accepted by the Chief Engineer. The total will be the maximum number of signs required and used for any one phase of construction.

Payment for Portable Changeable Message Sign will be at the contract unit price per each sign used or per hour that the Changeable Message Sign is in operation in the work zone, whichever unit is specified in the contract documents. The unit price bid shall include all labor, tools, materials and incidentals necessary to provide changeable message signs as specified. The Contractor shall operate the changeable message signs including setup,

programming, placing, providing all messages specified in the contract documents or requested by the Chief Engineer, maintenance and fueling, for which payment shall be reflected in the bid item for this work.

#### **616.19 STEEL PROTECTION PLATE**

- (A) **DESCRIPTION.** Work consists of furnishing, maintaining and relocating, if required, steel plates at the job site. Plates shall be used to protect open excavated areas, pot holes and areas where fresh concrete has been placed, all as specified in the contract documents and/or as directed. Steel plates shall be used to protect these areas for no longer than five (5) calendar days. Hot Mix Asphalt or High Performance Cold Mix, as defined in Section 819, shall be placed, compacted around the plate, and feathered to meet the existing pavement. Each plate shall be fastened to the pavement with four spikes. Unless otherwise specified in the contract documents, each plate shall be a minimum of 1 inch thick and of a suitable size to adequately protect the area. Work also includes removal of the plate from the job site when no longer required. Plates shall be clearly marked with the name and contact information of the owner and user of the plate. The mark shall be either on the plate itself, or within twelve (12") of the edge of the plate.
- (B) **MEASURE AND PAYMENT.** Unit of measure for Steel Protection Plate will be each. The total number will be the maximum number of plates used for any one phase of construction. Payment will be made at the contract unit price per each, which payment will include furnishing and placing plates and asphaltic concrete, spiking, relocating if required, and removal of the plates.

#### **616.20 REPAIR OF DAMAGED MAJOR TRAFFIC CONTROL DEVICES**

- (A) **DESCRIPTION.** Work consists of repairing, or replacing, if needed, major traffic control devices when damaged by vehicular traffic or vandalism that is deemed to be beyond the Contractor's control. For the purposes of this section, major traffic control devices are described under:
- |        |                                      |
|--------|--------------------------------------|
| 616.08 | Sequential Arrow Panels              |
| 616.15 | Truck Mounted Attenuator             |
| 616.16 | Construction Zone Attenuator         |
| 616.17 | Sand-Filled Impact Attenuator Module |
| 616.18 | Portable Changeable Message Sign     |
- (B) **MATERIALS.** Replacement materials are as described elsewhere for the original items. The ordering of materials shall be in accordance with the manufacturer's or supplier's recommendations.
- (C) **CONSTRUCTION REQUIREMENTS.** Construction requirements for use of each of the listed items are found in the section for that item and in the contract documents. Repair of listed devices shall be conducted in accordance with the manufacturer's recommendations. Regular maintenance (e.g. replacement of bulbs and lighting devices, etc.) and damage caused by the Contractor's own activities shall not be paid for under

this item and the cost of said work shall be considered when preparing bid prices for the original item.

- (D) **MEASURE AND PAYMENT.** The District will insert an estimated cost for this work in the Bid Forms and Proposal. No action is required of the bidder. The actual cost paid under Repair Of Damaged Major Traffic Control Devices for repair of each of the listed items will be the manufacturer's invoice cost plus 10% for all devices repaired or replaced as agreed to by the Chief Engineer. In cases where the manufacturer or supplier is needed to perform the repair, the associated labor costs shall be included in this item with the concurrence of the Chief Engineer. No payment will be made for the Contractor's labor involved in the repair of the device beyond the standard 10% markup indicated above.

When repair costs exceed the maximum dollar amount established by the District for this item, said amount will be increased to cover the estimated future costs of this work.

## **617 TRAFFIC SIGNALS**

### **617.01 DESCRIPTION.**

Traffic Signal work shall consist of furnishing all labor, equipment and materials and installing all electrical equipment, cabinets, conduits, manholes, pull boxes, wiring, cabinets, traffic signals, pedestrian signals, poles, and incidentals as shown in the contract documents, and as specified in this section for a complete working traffic signal system.

Wherever the word “provide” is used, it shall mean “furnish and install complete in place and ready for use.”

Items for traffic signal equipment shall consist of products of the same manufacturer, as far as practicable. The traffic signal system shall conform as to voltage, amperage, frequency, and type specified.

In order to provide the proposed lighting system the Contractor shall cooperate with the Potomac Electric Power Company (PEPCO). PEPCO will supply the power required for the locations outlined in the contract documents.

### **617.02 CODES AND STANDARDS**

Material, equipment and installation shall conform to the following:

American Society for Testing and Materials (ASTM)

American National Standards Institute (ANSI)

Certified Ballast Manufacturers

Institute of Electrical and Electronic Engineers (IEEE)

Insulated Power Cable Engineers Association (IPCEA)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

Underwriters Laboratories, Inc. (UL)

District of Columbia Electrical Code

National Electric Safety Code

United States of America Standards Institute (USASI)

Rules and Regulations of the Potomac Electric Power Company (PEPCO)

American Association of State Highway and Transportation Officials (AASHTO)

Electrical contractors must be bonded in the District and their electricians must have District licenses. The Contractor must secure a permit approved by the Electrical Engineer, D.C., prior to the beginning of any work, and the traffic signal work must at all times be

inspected by electrical inspectors and traffic signal technicians of the Department of Transportation (DDOT).

No work shall be covered or enclosed at any time prior to inspection.

The Contractor must have approved shop drawings, catalog cuts, and specifications available at the jobsite for inspection by the Chief Engineer and the Department's electrical inspector and traffic signal technician.

### 617.03 MATERIALS

- (A) **GENERAL.** New first quality materials shall be furnished in conformance with 825. Material and equipment must be UL listed and labeled. All electrical parts, wire, and other elements of the traffic signal installations shall be of ample capacity to carry required current without excessive heating or causing an excessive drop in potential. Except as otherwise provided herein, each individual item of traffic signal equipment shall bear a nameplate or other type of indelible marking or brand that shall identify it as to type, catalog number, and manufacturer. This applies to hardware and miscellaneous materials.
- (B) **COORDINATION WITH OTHER TRADES.** It shall be the responsibility of the Contractor to coordinate the location of equipment, conduit, devices, fixtures, etc., furnished and installed under other sections and by other trades to the extent that interference among such items is avoided. Relocation of items required as a result of failure of the Contractor to coordinate his work with the work of other trades shall be at the expense of the Contractor and at no additional cost to the District.
- (C) **STANDARD PRODUCTS.** Unless otherwise indicated, materials furnished shall be standard products of a manufacturer regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design complying with the specification requirements.

Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid. Specified materials shall be furnished.

- (D) **SAMPLES.** When samples are required they shall be submitted to the Chief Engineer for approval within 8 weeks after award of contract or prior to start of work, properly marked for identification and free of expense to the District. The District reserves the right to mutilate or destroy any sample submitted when considered necessary for testing purposes. Samples not so mutilated or destroyed will be returned to the Contractor at his expense when no longer necessary for the performance of the contract.

The Contractor shall submit the following:

- (1) The name and manufacturer of the equipment he proposes to furnish.
- (2) Such data and descriptive materials as may be necessary for the mechanical trades in connection with maintenance.
- (3) All signal wiring or necessary diagrams and drawings for approval.
- (4) Any additional samples if deemed necessary.

- (E) **MATERIAL AND WORKMANSHIP.** Installation work shall be in accordance with the contract documents. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired by the Contractor in a manner meeting the approval of the Chief Engineer without additional compensation.

The contract documents indicate the extent and general arrangement of the conduit and wiring systems. If departures from the contract documents are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted as soon as possible to the Chief Engineer for approval. No departures shall be made without prior written approval.

Materials and items of work shall be as specified herein in 825, and/or in the contract documents.

- (F) **GUARANTY.** The Contractor shall guarantee all traffic signal work to be in accordance with contract requirements and free from defective or inferior materials, equipment, and workmanship for a period of 1 year from date of acceptance of the traffic signal work.

If, within the guaranty period, the Department finds that guaranteed work needs to be repaired or changed because of the use of materials, equipment, or workmanship which are inferior, defective or not in accordance with the terms of the contract, DDOT shall so inform the Contractor in writing and the Contractor shall promptly and without additional expense to the District: (1) Place in a satisfactory condition all such guaranteed work; (2) Make good all damage to equipment, the site, the structure, and/or related appurtenances, which is the result of such unsatisfactory guaranteed work; (3) Make good any work, materials, and equipment that are disturbed in fulfilling the guarantee.

Should the Contractor fail to proceed promptly in accordance with the guarantee, the District may cause such work to be done and the Contractor and the surety or sureties under the bond shall be jointly and severally liable for the cost of same.

#### 617.04 CONTRACT PLANS AND MANUFACTURER'S DRAWINGS

- (A) **TRAFFIC SIGNAL PLANS.** These plans indicate the general arrangements of the traffic signal, pedestrian signals, circuits and conduits and the locations of poles and manholes. The contract documents are intended to show and describe the work entirely. However, every item necessary to complete the work may not be specifically shown or described. Incidentals not shown or specified, but necessary for the proper operation of the traffic signals at specific intersections or within the traffic signal system shall be included in the work. The Contractor shall be responsible for furnishing all materials for the installation, complete, so as to insure the successful operation of the signalized intersection or traffic signal system.
- (B) **MANUFACTURER'S DRAWINGS.** Manufacturer's drawings shall consist of all shop and installation drawings, catalogs, photometric curves, performance data, pole installation details, etc. The Contractor shall secure and/or prepare these drawings and submit them as required by 105.02 before purchasing materials or proceeding with construction. Shop drawings shall show complete details of construction for all portions of the work included. The Contractor shall check each drawing to insure conformance with the contract documents, and each drawing shall bear the Contractor's signature and

certification. Drawings and data not clearly identified will be returned without approval to the Contractor.

Transmittals accompanying all shop drawings shall contain names and addresses of the Contractor, subcontractors, and suppliers. Project title, reference to prior actions on submissions and specification reference shall also be indicated.

#### **617.05 TRAFFIC SIGNAL CONTROLLER CABINET FOUNDATION**

- (A) **DESCRIPTION.** The work consists of providing all labor, equipment and materials necessary to construct a foundation for the traffic signal controller cabinet, as shown on the contract documents, in conformance with the requirements for a Model 336SS Controller cabinet foundation, as detailed in the DDOT standard drawings, and in conformance with appropriate provisions of this specification. PCC Concrete for the foundations shall conform to 817.03 (A) Class F.

The foundations shall be installed 36 inches from the face of curb to centerline of foundation or as noted on the contract documents. Forms shall be true to line and grade. Conduit ends and anchor bolts shall be placed in proper position and to the proper height, and shall be held in place by means of template until the concrete sets. The foundation shall have five (5) conduits installed. A 2 inch conduit shall be installed through the foundation for the installation of the ground rod. A two inch (2") diameter conduit shall be routed toward the existing PEPCO manhole shown on the contract documents for electrical service. The third two inch (2") diameter conduit shall be routed toward the proposed DC manhole shown on the contract documents for the communications cable. The two four inch (4") diameter conduits shall be routed toward the proposed DC manhole shown on the contract documents for cables to traffic and pedestrian signal heads. The conduit shall extend a minimum of two inches (2") and a maximum for four inches (4") above the top of the finished foundation. The 3/4" diameter ground rod, #6 solid copper ground wire, and ground clamps, shall be included in the cost for this item. The anchor bolts shall be set to the correct location and project 3" above the foundation. The foundation shall be allowed to set for a minimum of 3 days before installing the cabinet. All material excavated and other debris shall become the property of the Contractor and shall be disposed of by him at no additional cost to the District.

All conduits shall be schedule 40 PVC. Each conduit installed to accommodate cable shall feature a radius sweep of 36 inches so as to meet the underground electrical conduit at the proper elevation beneath grade. In addition, the 3/4" inch copper clad ground rod shall be of sufficient length to ensure that a minimum length of 8 feet is driven into undisturbed soil.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Controller Cabinet Foundation will be each. Payment will be made at the contract unit price for each Traffic Signal Controller Cabinet Foundation. The payment shall include the cost of excavation, PCC concrete, anchor bolts, ground rod, reinforcing steel, ground clamps, No. 6 solid ground wire and Schedule 40 conduits with the entire 36 inch sweep length where appropriate. The payment shall also include all labor, materials, equipment and incidentals necessary to complete the work specified herein and completely clean the site of all debris.

**617.06 FOUNDATION FOR TRAFFIC SIGNAL POLE**

- (A) **DESCRIPTION.** The Contractor shall furnish all labor, equipment and materials necessary to construct a foundation for a traffic signal pole or a pendant post streetlight pole as shown in the contract documents, in conformance with the standard drawings for a 15" diameter bolt circle pole foundation, and in conformance with appropriate provision of these specifications. PCC Concrete for the foundations shall conform to 817.03 (A) Class F.

The distance from the face of the curb to the centerline of the foundation shall be not less than 36 inches or as noted in the contract documents. Forms shall be true to line and grade. Conduit ends and anchor bolts shall be placed in proper position and shall be held in place by means of a template until the concrete sets. The foundation shall have three (3) conduits installed. All conduits shall be Schedule 40 PVC. A 1.5 inch diameter conduit shall be installed through the foundation for the installation of the ground rod. One 2 inch diameter and one 4 inch diameter conduit shall be routed from the foundation toward the manhole(s) designated in the contract documents. The conduits shall extend a minimum of 2 inches and a maximum of 4 inches above the grade of the foundations. Each conduit installed to accommodate cable shall feature a radius sweep of 36 inches so as to meet the underground electrical conduit at the proper elevation beneath grade.

The four anchor bolts shall be set at the correct location forming a 15 inch diameter bolt pattern as shown in the contract documents. Each bolt shall project 3 inches above the top of the foundation. Anchor bolts shall be in conformance with 822.06 (B). The foundation shall be allowed to set for a minimum of 3 days before installing the transformer base. All excavated material and other debris shall become the property of the Contractor and shall be disposed of at no additional cost to the District.

The 3/4 inch diameter copper clad ground rod, the No 6 solid ground wire, and the ground clamps shall also be included. The ground rod shall be of sufficient length to ensure that a minimum length of 8 feet is driven into undisturbed soil.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Foundation For Traffic Signal Pole will be each. The payment for Foundation For Traffic Signal Pole will be at the contract unit cost for each foundation and will include excavation, PCC concrete, anchor bolts, ground rod, reinforcing steel, ground clamps, No. 6 solid copper ground wire and Schedule 40 conduits with the entire 36 inch sweep, where appropriate. The payment will also include all labor, materials, equipment, and incidentals necessary to complete the work specified herein and completely clean the site all debris.

**617.07 ELECTRICAL CABLES FOR TRAFFIC SIGNALS**

- (A) **DESCRIPTION.** The work consists of providing traffic signal cable for traffic signal intersections and the traffic signal system in conformance with the requirements of 621.11, Wiring Systems; 621.12, Cable Connections; 621.13, Circuit Identification; and these specifications. Electrical cables shall be looped in and out of controller cabinets, communications termination cabinets, manholes, hand boxes, poles and transformer bases to provide a minimum 3 feet of slack. Cable shall be pulled to ensure minimum stress on cables, conductors and connectors. All cable runs are to be continuous with no splices permitted in conduits, manholes, transformer bases, poles, or hand boxes.

Electrical cables for traffic signals shall be routed through conduits, manholes and overhead as shown in the contract documents or approved working drawings. Cable routings shall be adapted to match field changes resulting in conduit, manhole, foundation, controller, or hand box relocations.

The Contractor will be required to provide the following different types of cable in conjunction with this work; cable running between the controller and signal heads, detector lead-in cable, and twisted pair copper communications cable. Ground cable is addressed in conjunction with grounding and bonding, Section 618.

## **(B) SPECIFICATIONS**

### **1. Cable Between the Controller and Signal Heads**

The cables running between the traffic signal controller and signal heads shall be 7 Conductor 14 AWG stranded cable conforming to the most recent requirements of the International Municipal Signal Association Inc. (IMSA) Specification No 19-1. A signal head shall be defined as a traffic signal head, pedestrian signal head, school or warning flasher, neon sign or fiber-optic electronic regulatory or lane control sign.

### **2. Detector Lead-in Cables**

The cables running between the traffic signal controller and specified detection equipment shall be 4 conductors 18 AWG shielded, stranded cable. This cable is "Non IMSA spec" and frequently goes by the catalog code as No. 4C18 B7 OS-F. Detection equipment shall be defined as pedestrian push button, microwave vehicle detector or loop detector. Cables serving loop detectors shall be coiled in the appropriate hand box.

### **3. Communication Cables**

Underground communications cable shall satisfy all of the requirements of IMSA 60-2 or REA PE-39. Aerial (overhead) communications cable shall meet all of the requirements of IMSA 40-2 or REA PE-22. Communications cable that runs partly overhead and underground shall meet the requirements of IMSA 60-2 or REA PE-39. DDOT uses 12 pair, 25 pair, 50 pair, and 100 pair communications cables in its traffic signal plant. Precise cable routing as with the number of pairs required are shown on each individual plan set. All signal conductors shall be color coded in accordance with IMSA Specification 19-1-1967, Table 2. The Contractor shall furnish a manufacturer's certification that the cables conform to the requirements of IMSA or ASTM Specifications referenced for each type of cable furnished.

### **4. Connectors and Terminals**

Connections and terminals shall conform to the requirements of NEC 110 for the type of cables specified in the contract documents and shall conform to the manufacturer's recommendations.

## **(C) INSTALLATION PROCEDURES**

The following wiring procedures will be strictly adhered to when wiring electrical devices to operate as part of a signalized intersection or traffic signal system.

1. All cable segments shall be identified with a waterproof tag securely affixed to the cable in the controller cabinet, all pull boxes, hand boxes, and manholes, and in all transformer bases.
2. All cable shall satisfactorily pass the megger tests. Cable failing the megger test shall be replaced by the Contractor at no cost to the District.
3. Cables shall be pulled through electrical conduits, manholes, controller cabinet, poles, and mast arms in accordance with the following procedures.
  - a. Cables shall be installed and pulled so as not to damage the cable or exceed the manufacturer's recommendations for bending radius or pulling tension.
  - b. Cables may be installed or removed in duct lines that may contain energizing cables. All duct rodding shall be performed with a non-conductive rod and appropriate safety precautions shall be followed.
  - c. Cables shall be pulled in and through the conduit with a cable grip designed to provide a firm hold on the exterior covering of the cable. Cable shall be pulled with a minimum of dragging on the ground or pavement.
  - d. Powdered soapstone, talc, or other approved lubricants may be used to facilitate the pulling of cable. In any event, lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer.
  - e. Cables shall be looped in and out of the controller cabinet, manholes, hand boxes, and poles to provide adequate slack and the minimum amount of stress on conductors and connectors. Cable runs shall be continuous with no splices in the conduit, manholes, hand boxes, transformer bases or anywhere along an overhead cable run.
  - f. No branch splices of cable shall be permitted between the traffic signal controller and any signal head, detection device, or communications facility. Straight splices of cable are permissible only with the approval of the Chief Engineer utilizing splice kits that totally encapsulate the cable and produce a waterproof splice.
  - g. Cables shall be racked neatly and securely supported in all manholes.
    1. Cables shall be identified with a waterproof tag securely affixed to all cables in each manhole, hand box, transformer base and controller or termination cabinet. The Contractor shall prepare and affix each cable tag. Traffic signal system cables entering or leaving a controller cabinet shall be tagged to identify the type of signal head (vehicle, pedestrian, flasher, electronic sign) or detection device (push button, microwave detector, loop detector) being serviced, and the signal head or detector number as defined by the signal configuration package or the traffic signal sequence of operation. Communications cable shall be identified by trunk and cable pair number. Identification tags shall contain the following minimum information:

CABLE No. 1, SIGNAL No. 1 – For cables servicing vehicle or pedestrian signal heads, flashers, electronic signs.

CABLE No. 2, PED P.B.A – for cables serving pedestrian push buttons

CABLE No. 3, HANDBOX A, LOOP L-1 – For cables to be spliced into specific loop detectors in designated hand boxes

CABLE No. 4, Microwave Det A – For cables servicing microwave vehicle detectors.

**(D) VEHICLE SIGNAL HEADS**

1. All cable shall contain 7 conductors.
2. The cable to be used shall be 14 AWG, stranded, THHN, manufactured according to the IMSA 19-1, specification.
3. The seven conductors are color coded as follows: Red, Orange, Green, Blue, Black, White, and White with a Black tracer.

Note: Existing seven conductor cable may be color coded as follows in some cases: Red, Amber or Yellow, Green, Red w/Black Tracer, Black, Green w/ Black tracer, and White.

4. The conductor coded with white insulation will be the system neutral.
5. The conductors coded with Red, Orange, and Green or Red, Amber or Yellow and Green insulation will be used for vehicle signal heads controlling traffic moving in the north-south direction.
6. The conductors coded with Blue, Black, and White with a Black Tracer or Red with a Black Tracer, Black and Green with a Black Tracer will be used for vehicle signals heads controlling traffic in the east-west direction.
7. Unused conductors to each signal head will be reserved for use in the event that the sequence of operation is modified and additional sections are required, or if one or more of the conductors currently in use fail.
8. A separate segment of 7- conductor cable shall be routed from the traffic signal controller to each vehicle signal head. However, cable may be routed between the terminal blocks of two signal heads if the following criteria are satisfied:
  - a. the two vehicle signal heads must operate identically.
  - b. the two vehicle signal heads must be mounted on the same pole, or
  - c. one of the two vehicle signal heads must be pole-mounted and the other is mounted on a mast arm.
  - d. the cable shall not exist in the underground conduit network.
9. No branch splices of cable shall be permitted at any point between the traffic signal controller and the signal head, or between vehicles signal heads that are wired between their terminal blocks. Straight splices of cable shall not be made unless approved by the Chief, Traffic Signal System Division.

10. In the event of a cable malfunction involving new and existing cable installed by the Contractor in accordance with these policies, the following policies apply:
  - a. all new cable is required to be replaced if found defective or damaged.
  - b. if there are a sufficient number of unused conductors in the existing cable, they will be used in lieu of the defective conductors. The cable shall be tagged in the controller cabinet to indicate which conductors are defective.
  - c. if there are an insufficient number of unused conductors in the existing cable to replace the defective conductors, a new segment of 7 – conductor cable shall be pulled from the controller cabinet to the signal head.
  - d. under no circumstances will it be permissible to replace the defective segment of cable with a new segment of cable utilizing straight splices connecting the new with the old cable.
11. Unless otherwise specified in the contract documents, all cable for vehicle signal heads is to be furnished and installed by the traffic signal installation Contractor.
12. If inspection of the traffic signal work by District forces shows any unauthorized deviations from the provisions of this policy, the Contractor shall be obligated to make appropriate revisions at no cost to the District before final payment for the job is released.

**(E) PEDESTRIAN SIGNAL HEADS**

1. The provisions of 617.07 (D) No. 1, 2, 3, 4, 7, 10, 11, 12 apply.
2. The conductors coded with red and green insulation will be used for pedestrian signal heads controlling pedestrian in the north-south direction.
3. The conductors coded with White w/Black tracer and Blue or Red w/Black tracer and Green w/Black tracer will be used for pedestrian signal heads controlling traffic in the east-west direction. The Orange and Black conductors shall be used together where additional conductors are required.
4. All new signal installations and modifications are to be designed so as to install a pair of pedestrian signal heads on the same pole. A separate segment of 7- conductor cable shall be routed from the traffic signal controller to each pair of pedestrian signal heads. The appropriate conductors and the system neutral are to be routed through the brackets to the terminal block of the signal head.
5. In instance where pedestrian signal heads on the same corner of the intersection must be mounted on separate poles, a separate segment of 7- conductor cable is to be routed to each pedestrian signal head.
6. No branch splices of cable shall be permitted at any point between the traffic signal controller and the signal head. Straight splices of cable shall not be made unless approved by the Chief, Traffic Signal System Division.

**(F) PEDESTRIAN PUSH BUTTONS**

1. All cables shall consist of 4 conductors.

2. The cable to be used shall be 18 AWG, stranded, twisted, shielded cable manufactured according to DDOT specifications.
3. A separate segment of cable shall be rerouted from the controller cabinet to each pedestrian push button.
4. In the event of a cable malfunction involving cable installed in accordance with these policies, a new segment of 4-conductor cable shall be pulled from the controller cabinet to the pedestrian push button. Under no circumstances will it be permissible to replace the defective segment of cable utilizing straight splices connecting the new with the old cable.
5. Unless otherwise specified in the contract documents, all cable is to be furnished and installed by the traffic signal installation contractor.
6. If inspection of the traffic signal work by District forces shows any unauthorized deviation from the provisions of this policy, the Contractor shall be obligated to make appropriate revisions at no cost to the District before final payment for the job is released.

**(G) LOOP DETECTOR LEAD-IN CABLE**

The provisions of items 617.07 (F), 1, 2, 3, 4, 5, and 6 for pedestrian push buttons apply for loop detector lead in cable. In the aforementioned policy statements, the term pedestrian push button is to be replaced by the term loop detector hand box.

**(H) MICROWAVE VEHICLE DETECTOR LEAD-IN CABLE**

The provisions of item 617.07 (F), 1, 2, 3, 4, 5, and 6 for pedestrian push buttons apply for microwave vehicle detection or lead-in cable. In the aforementioned policy statements, the term pedestrian push button shall be replaced by the term microwave vehicle detector.

**(I) LOOP DETECTOR CABLE**

1. All cable shall contain 1 conductor.
2. The cable to be used shall be 14 AWG, stranded, THNN manufactured according to the latest IMSA specifications.
3. The cable is to be routed from the loop detector hand box, around the slot cut into the pavement and back to the loop detector hand box.
4. The dimensions of the loop detector and the number of turns of cable required will be clearly identified in the contract documents.
5. The cable shall contain no splices other than those made with the shielded lead-in cable in the hand box.
6. In the event of a cable malfunction, a segment of 1 conductor cable shall be pulled in a newly cut pavement slot according to the provisions of item 3. Under no circumstances will it be permissible to replace the defective segment of cable utilizing straight splices connecting the new with the old cable.
7. Unless other specified in the plans, all cable is to be furnished and installed by the traffic signal installation contractor.

8. If inspection of the traffic signal work by the District forces shows any unauthorized deviation from the provisions of this policy, the Contractor shall be obligated to make appropriate revisions at no cost to the District before final payment for the job is released.
9. All splices between the loop detector cable and the loop detector lead-in cable shall be made in the loop detector hand box utilizing waterproof, encapsulating splice kits satisfying DDOT specifications.
10. Whenever practical, loop detectors shall be cut in the PCC roadway base before the surface course is applied. The megger test shall be given to the loop detector cable both before and after the surface course is applied. The loop detector shall be recut, at no cost to the District, if the cable fails the megger test. It will be permissible to cut the loop detector in the surface course after the surface course has been applied.

**(J) FIBEROPTIC ELECTRONIC SIGNS**

1. The provisions of 617.07 (D) No. 1, 2, 3, 4, 7, 10, 11, 12 apply.
2. The color coded conductors used to operate the electronic signs are to be noted in the controller cabinet.
3. A separate segment of 7-conductor cable shall be routed from a designated traffic signal controller to each electronic sign.

No branch splices of cable shall be permitted at any point between the designated traffic signal controller and the electronic sign. Straight splices of cable shall not be made unless approved by the Chief, Traffic Signal Systems Division.

**(K) FLASHING BEACONS FOR SCHOOL OR WARNING SIGNS**

1. The provisions of 617.07 (D) No. 1, 2, 3, 4, 7, 10, 11, 12 apply.
2. Unless otherwise noted, flashing beacons are to be installed in a pairs; one above and one below each sign.
3. A separate segment of 7-conductor cable is to be routed from the designated traffic signal controller to a control cabinet to be mounted on the pole to which the beacons are affixed. This cable will terminate at the terminal block be furnished and installed by the traffic signal installation contractor.
4. A separate segment of 7-conductor cable is to be routed from the terminal block of the pole mounted cabinet to each pair of flashing yellow beacons. Unless otherwise noted in the contract documents, this segment of cable will be furnished and installed by the Contractor.
5. The conductor color coded red will be routed from the controller through the pole mounted cabinet to the top beacon visible to northbound or southbound traffic.
6. The conductor color coded green will be routed from the controller through the pole mounted cabinet to the bottom beacon visible to northbound or southbound traffic.
7. The conductor color coded White w/Black tracer or Red w/Black tracer shall be routed from the controller through the pole mounted cabinet to the top beacon visible to eastbound or westbound traffic.

- 8. The conductor color coded Blue or Green w/Black tracer shall be routed from the controller through the pole mounted cabinet to the bottom beacon visible to eastbound or west bound traffic.

**(L) TRAFFIC SIGNAL CABLE COLOR CODES.**

**1. 7 Conductor 14 AWG Stranded Cable**

ISMA Cable Color Code:	Green	
	Orange	NB/SB Traffic
	Red	
	Blue	
	Black	EB/WB Traffic
	White/Black	
	WhiteAC-	

**2. Old Cable Color Code:**

Green	
Yellow	NB/SB Traffic
Red	
Green/Black	
Black	EB/WB Traffic
Red/Black	
White	AC-

**(M) INSTALL TWISTED PAIR COMMUNICATION CABLE**

1. Underground communications cables shall meet all requirements of IMSA 40-2 or REA PE-39. Aerial (overhead) communication cable shall meet all of the requirements of ISA 40-2 or REA PE-39. Communications cable runs that are partly overhead and underground shall meet the requirements of IMSA 60-2 or REA PE-39.
2. Cable shall be pulled in conduit with a cable grip designed to provide a firm hold on the exterior covering of the cable. Cable shall be pulled with a minimum of dragging on the ground or pavement. Powdered soapstone, talc or other approved lubricants shall be used to facilitate the pulling of the cable.
3. Communication cable shall also be installed on messenger cable when shown in the contract documents as overhead cable. Cable shall be looped in and out of controller cabinets, and ground-mounted termination cabinets at termination points or splice points as indicated in the contract documents.
4. Communications cable shall be installed for the traffic signal control system. Cable runs shall be continuous with no splices in the conduit, manhole, pull boxes, or overhead runs.
5. All large cables, over twenty-five (25) pairs, shall terminate in termination cabinets only. Connection between the terminating cabinets and the intersecting controllers

shall be made with twelve (12) or twenty-five (25) pair cables only as indicated on the Communications Cable Schematic Sheet of the contract documents.

6. The communications cable in an intersection controller shall be terminated by the Contractor on a terminal block mounted in the cabinet. The cable connection between the terminal block and the communication modem shall be through the controller's communication connector (C2).
  7. Cable ends shall be taped to exclude moisture and shall remain so until terminal equipment is attached by the Contractor. For cable connections in termination cabinets, connectors approved for outside use shall be used.
  8. Cables shall be looped in and out of controller cabinets, termination cabinets, manholes and pull boxes to provide adequate slack and the least amount of stress on the conductors and connectors.
  9. If an emergency cable condition exists, where a splice is permitted in underground and overhead runs, the splices shall be made in the appropriate manner using a waterproof splice kit conforming to the requirements of the National Electric Code (110b.14). Boxes or kits should be of sufficient size to allow free space to all conductors therein. All splices shall be capable of operation when submerged in water. All splices and conductors, including spares, shall be made waterproof and mechanically and electrically secure.
  10. Before any cable is pulled into the conduit, provisions shall be made to support the cable ends on racks in the manholes.
  11. Cable shall not be allowed to lie on the manhole floor.
  12. The channels that support the racks shall be securely fastened to the manhole wall with expansion bolts. The spacing between racks adjacent to the proposed cable joint shall be a minimum of 36 inches.
  13. Communication cable shall be furnished on reels and pulled with a minimum of dragging on the ground or pavement.
  14. Work shall also include the removal and disposal of existing communications cable that will be replaced by the new cable run.
  15. The Contractor shall disconnect the old and connect the new communications cable in all controller cabinets. The Contractor shall pull the cable into the cabinets.
  16. When modifying or upgrading existing signalized intersections, the Contractor shall not disconnect existing communications cable from the controller cabinet until new communications cable is terminated at the new controller cabinet, or until call new communications cables have been pulled, tested, and in place awaiting controller change out on the same foundation.
- (N) **MEASURE AND PAYMENT.** The unit of measure for Electrical Cable for Traffic Signals will be the linear foot. The number of linear feet will be the actual number of linear feet in place, including the loop-in-cable. The payment will be made at the contract unit price for the linear feet of Electrical Cable for Traffic Signals, and which price will include all labor, equipment, materials, and incidentals required to provide and test the cables, and to complete all work specified herein.

**617.08 STEEL TRAFFIC SIGNAL POLE**

- (A) **DESCRIPTION.** The work consists of providing Steel Traffic Signal Poles of the length specified in the contract documents. All holes necessary to allow for cable entry into signal heads, mast arms, and pedestrian and vehicular detection equipment shall be drilled and finished prior to the erection of the pole onto the transformer base. All holes must be made prior to the installation of any cable into the pole.

The Contractor shall set the pole on a leveled and trued transformer base with the holes in the pole base casting lining up with the holes on the top of the transformer base. The Contractor shall use the 1" x 3" galvanized steel bolts with nuts and washers, provided with the procurement of the transformer base, to attach the pole to the transformer base. The Contractor shall apply sufficient torque to ensure a secure, stable connection. Grounding the pole is unnecessary if the transformer base is grounded. The Contractor shall have the option of routing cable for signal heads and detection equipment through the pole before the pole is erected, or providing a means for installing cable without splices or damage after the pole is erected. After the bolts have been secured and tightened, the Contractor shall install the removable ornamental pole top finial and the four ornamental cast leaf bolt covers where specified in the contract documents.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Steel Traffic Signal Pole will be each. The payment for Steel Traffic Signal Pole will be paid at the contract unit price for each pole complete in place. The price will include all labor, equipment, tools, material and incidentals to complete the work specified herein.

**617.09 TRAFFIC SIGNAL MAST ARM**

- (A) **DESCRIPTION.** The work consists of providing Traffic Signal Mast Arms for traffic signal poles of the clamp-on type in the length specified in the contract documents with removable caps and clamps conforming to Section 820 and the standard drawings.

The Contractor shall drill a hole in the pole at the point where the mast arm is to be mounted. The location of the hole is a function of the height of the bottom of the signal head to be installed on the mast arm above the pavement. The height above the pavement may be determined from the standard drawings. The hole shall be approximately 2 inches in diameter and of such size that the mast arm completely covers the entire hole. The edges of the hole shall be machined to remove burrs that may snag the cable.

The installation of the mast arm onto the pole shall be undertaken after all required cable has been pulled through the hole drilled into the pole. The Contractor shall route electrical cables through the interior of the mast arm and out of the hole(s) previously cut in the mast arm for the mast arm mount signal bracket(s). Being careful not to crimp any of the cable, the Contractor shall affix the mast arm to the pole using the clamp. The Contractor shall line up the hole in the clamp with the hole in the pole and make the attachment using the high strength galvanized connecting bolts. The bolts shall be tightened per manufacturer's specification to ensure a secure, tight installation. The Contractor shall apply a continuous bead of waterproof sealant at all.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Mast Arm will be each. The payment for Traffic Signal Mast Arm will be paid at the contract unit price for

each mast arm complete in place. The payment will include all labor, equipment, tools, material and incidentals to complete the work specified herein.

#### **617.10 LED SIGNAL MODULE**

- (A) **DESCRIPTION.** The work consists of providing LED Signal Modules for traffic signals, warning flashers and pedestrian signals at locations specified in the contract documents. The LED Signal Modules shall conform to Section 825 and installed according to the manufacturer's recommendations.

The following LED modules are used in the DDOT:

- 12 inch Red Ball LED Module
- 12 inch Yellow Ball LED Module
- 12 inch Green Ball LED Module
- 12 inch Red Arrow LED Module
- 12 inch Yellow Arrow LED Module
- 12 inch Green Arrow LED Module
- 12 inch Portland Orange Raised Hand LED Module
- 12 inch Lunar White Walking Person LED Module

The Contractor shall provide the LED Signal Modules at the locations specified in the contract documents. The contract may specify the procurement and delivery to the District. In that case, the Contractor shall be responsible for safe keeping and storage of the module at the Contractor's facility following receipt of the materials from the vendor. Payment to the Contractor by the District shall be authorized only after the module has been delivered to and remains within DDOT.

- (B) **MEASURE AND PAYMENT.** The unit of measure for LED Signal Module will be each. The payment for LED Signal Module will be paid at the contract unit price for each module complete in place or delivered to the District whichever is specified. The payment will include all labor, equipment, tools, material and incidentals to complete the work specified herein.

#### **617.11 POLE MOUNTED VEHICULAR OR PEDESTRIAN TRAFFIC SIGNAL HEAD**

- (A) **DESCRIPTION.** The work consists of providing Pole Mounted Vehicular or Pedestrian Traffic Signal Head, and upper and lower mounting brackets and hardware, as described herein. The traffic signal poles will be either steel traffic signal poles, pendant poles or Washington Standard poles. The work to be performed is as follows:

1. The Contractor shall drill a hole in the pole at the point where the upper signal head mounting bracket is to be installed. The hole shall be approximately one inch in diameter, and edges shall be machined to remove burrs that may snag cable.
2. The Contractor shall prepare the signal head for attachment to the pole prior to arriving in the field at the intersection. The Contractor shall construct each signal head as described in the traffic signal sequence of operation. The appropriate LED

modules shall be inserted and affixed into the housing and wired to the signal head terminal block, in accordance with manufacturer's instructions. Tunnel visors may be attached at this time or after the signal head is erected.

3. Pole mounted one, two, three, four and five section signal heads shall feature sections mounted vertically one above the other. Connections between signal head sections shall be watertight and contain an opening through which cable can pass.

Pole mounted signal heads shall be outfitted with upper and lower mounting brackets. This assembly shall feature serrated locking washers at the signal head to prevent misalignment. This assembly shall be attached to the signal head and to the pole such that a watertight barrier results. This shall be accomplished through the use of washers and/or sealing compound at the pole. The assembly shall consist of 1-½ inch diameter steel tubes (nipples) threaded to fit into the pole plate and into the 90 degree ell leading to the signal head. The other end of the assembly shall be affixed to a universal pole plate into which the 1- ½ inch diameter steel nipple can be screwed. The universal pole plate may constructed from cast aluminum and shall be structured to accept 1 inch wide stainless steel banding strapping above and below the nipple where the plate sits next to the pole. The 1-½ inch steel nipple shall be of sufficient length and configuration to match the hardware arrangement of this signal display being replaced and to situate the signal head equidistant from the pole as the signal display being replaced.

4. The field cable protruding through the hole in the pole is to be carefully routed through the mounting hardware into the signal head and connected to the proper terminals in the terminal block of the signal head. The Contractor shall make the proper electrical connections of the field cable to the terminal block and ascertain that the connections are secure and consistent with the approved traffic signal sequence of operation. The field cable shall be fitted with terminal lugs for attachment to the terminal block.
5. The Contractor shall mount the signal head assembly to the pole after carefully aligning the universal pole plate to the pole without damaging or crimping field cable. Each new signal head will be mounted so that the bottom of the signal head is at a height above grade equal to the signal head being replaced. The universal pole plate shall be affixed to the pole utilizing 1 inch wide stainless steel banding strapping two points on each pole plate, one above and one below where the nipple screws into the pole plate. The mounting shall be accomplished with banding tools specifically intended for securing banding strapping and with standard tools.
6. The Contractor shall ensure a secure fit of the assembly and confirm that the signal head operates in compliance with the approved traffic signal sequence of operation.

**(B) MEASURE AND PAYMENT.** The unit of measure for Pole Mounted Vehicular or Pedestrian Traffic Signal Head traffic signal head installed will be each. The payment will be made at the contract unit price for each signal head complete in place. The price will include the signal head housing, the upper and lower mounting brackets, universal pole plate, all miscellaneous hardware including terminal lugs, tunnel visors, stainless steel banding materials, and all labor, equipment and materials. The price shall also include insertion, affixing and wiring of the LED module into the signal head. The cost of the LED module is detailed in 617.10.

**617.12 MAST ARM MOUNTED VEHICULAR TRAFFIC SIGNAL HEAD**

- (A) **DESCRIPTION.** The work consists of providing Mast Arm Mounted Vehicular Signal Heads, upper and lower mounting brackets and hardware, as described herein. After receiving the Chief Engineer's approval of catalog cuts, the Contractor shall procure vehicle signal head housings, vehicle signal back plates and mast arm mount signal brackets conforming to 825 and the standard drawings. The work to be performed is as follows:
1. The Contractor shall procure the materials described above.
  2. The Contractor shall drill a hole in the mast arm at the point where the mast arm mount signal bracket is to be installed. The hole shall be approximately one inch in diameter, and edges shall be machined to remove burrs that may snag cable.
  3. The Contractor shall prepare the signal head for attachment to the mast arm prior to arriving in the field at the intersection. The Contractor shall construct each signal head as described in the plans. The appropriate LED modules shall be inserted and affixed into the housing and wired to the signal head terminal block, in accordance with manufacturer's instructions. Tunnel visors may be attached at this time or after the signal head is erected.
  4. Mast arm mounted one, three and four section traffic signal heads shall feature sections mounted one above the other. Mast arm mounted five section traffic signal heads shall feature two adjacent columns of two sections each mounted one above the other and one section mounted directly above the other two so that the total assembly is three sections tall and two sections wide and so that the center of the top section coincides with the line vertically dividing the two columns.
  5. Mast arm mounted signal heads shall feature a back plate affixed to the signal head. Back plates are to be procured in accordance with the technical specifications contained in the contract documents. The back plate shall be secured to the signal head utilizing the hardware shown in the technical specifications and in accordance with the manufacturer's instructions.
  6. Mast arm mounted signal heads shall be mounted to the mast arm at the point where the field cable exits the mast arm with a standard bracket assembly, procured in accordance with technical specifications contained in the contract.
  7. All mounting hardware shall be affixed to the signal head to form a watertight joint in compliance with the manufacturers' installation instructions.
  8. The existing field cable protruding through the hole in the mast arm is to be carefully routed through the mounting hardware into the signal head completely within the assembly and connected to the proper terminal in the terminal block of the signal head. The field cable shall be fitted with terminal lugs for attachment to the terminal block. The Contractor shall make proper electrical connections of the field cable to the terminal block and ascertain that the connections are secure and consistent with the approved traffic signal sequence of operation.
  9. The Contractor shall mount the signal head assembly to the mast arm after carefully aligning the mast arm mount signal bracket to the pole without damaging or crimping field cable. Each new signal head shall be mounted so that the bottom of

the signal head is at a height above grade equivalent to the signal head being replaced. The Contractor shall tighten the stainless steel bands on the signal brackets to the mast arm to ensure a tight, secure fit utilizing specific banding tools and/or standard tools.

10. The Contractor shall make adjustments after the assembly is affixed to the mast arm to ensure proper alignment of the signal head.
  11. The Contractor shall ensure a secure fit of the assembly and confirm that the signal head operates in compliance with the approved traffic signal sequence of operation.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Mast Arm Mounted Vehicular Signal Heads will be each. The payment will be made at the contract unit price for each signal head complete in place. The price will include the signal head housing, the complete mast arm mount signal bracket, the back plate, tunnel visor, terminal lugs, stainless steel banding materials, all miscellaneous hardware and all labor, equipment and materials. The price shall also include insertion, affixing and wiring of the LED module into the signal head. Payment for LED module shall be as per 617.10.

### 617.13 PEDESTRIAN PUSH BUTTON CONTROLS

- (A) **DESCRIPTION.** The work consists of providing Pedestrian Push Button Controls as indicated in the contract documents and conforming to this specification and 825.

The Contractor shall drill a hole in a traffic signal pole at the point where the pedestrian push button is to be mounted. The height of the hole above ground level shall be consistent with the requirements of the Americans With Disabilities Act (ADA) and as shown in the contract documents.

The hole shall be no more than one inch in diameter and of such size that the pedestrian push button completely covers the entire hole. The edges of the hole shall be machined to remove burrs that may snag the cable.

The Contractor shall make electrical connections at the terminal block of the pedestrian push button. Appropriate conductor(s) from the 4-conductor 18 AWG lead in cable and a No. 6 bare copper ground cable shall be connected to the pedestrian push button. The ground wire shall be attached to the ground rod in the pole foundation.

After the cable is attached, the pedestrian push button shall be affixed to the metal pole utilizing three quarter inch wide stainless steel banding strapping at two points on each pedestrian push button, one above and one below the plunger. The Contractor shall apply a continuous bead of waterproof sealant around the push button at the pole to preclude the flow of moisture and debris to the back of the push button.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Pedestrian Push Button Controls will be each. Payment will be made at the contract unit price for each Pedestrian Push Button Control complete in place, and which payment will include the pedestrian push button, mounting and grounding materials and all labor, equipment, materials and incidentals required to prepare the pole, make electrical connections, and affix the pedestrian push button to the pole.

### 617.14 INDUCTIVE LOOP DETECTORS

(A) **DESCRIPTION.** The work consists of providing Inductive Loop Detectors as indicated in the contract documents. Inductive Loop Detectors shall consist of, but not be limited to, loop detection cable, loop detector slot sealant and waterproof, encapsulating splice kits in conformance with 825 and these specifications.

1. The Contractor shall furnish all labor, equipment and materials for the installation of inductive loop detector(s). Specific loop detectors locations and dimensions are as shown in the contract documents. The Contractor shall utilize Standard Drawings 617.26 and 617.27 as the guideline to be followed for typical loop detector installation.

The Contractor shall be familiar with the installation procedures and materials to be utilized, and shall visit the site in advance of actual installation. The Contractor shall plan and schedule daily operations as to accomplish all preparatory tasks prior to commencing the actual installation at the proposed site and shall complete the installation of all loops in the same day.

Work shall consist of furnishing and installing loops, conduits and splices between loop detectors and lead-in cables, unless the Contractor can protect the unfinished loops and/or saw cuts from traffic. The Contractor shall furnish all required materials for the work and shall tests on the system satisfactorily, as detailed herein.

The Contractor shall notify the Chief Engineer when the loops are to be installed. The placement of loop wires, the megger test, and the sealing of the loops shall not be performed except in the presence of the Chief Engineer or Electrical Inspector.

Loop Layout – The Contractor shall lay out all vehicle loops and lead lines using spray paint, with or without template. No saw cutting of the pavement shall be done until the loop layout has been verified by the Chief Engineer. Loop locations as shown in the contract documents must be maintained.

Loop Installation – The saw cut for the lead-in to the hand box shall be made as close as possible to the curb without marring the curb. The pavement chase from the saw cut end to the curb shall be made with a punch or drill and not by excavating methods.

One ¾ inch conduit for each loop lead shall be installed under the pavement from end end of the saw cut to the handbox. The part of the curb above the pavement shall not be drilled or cut for conduit installation. A bronze bushing shall be installed on the conduit stub-out to prevent damage to top lead-in wires.

The conduit shall be installed in a direct line with the saw cut so that the wires entering the conduit shall not need to be bent. The cover over the conduit shall be of the same material that is used to seal the saw cut.

Self-propelled concrete cutting equipment shall be utilized. The machine shall have the capability of utilizing either a local or tank-supplied water source of adequate pressure to act as a blade coolant, lubricant, and slot cleaner. The diamond blades to be utilized for the saw cut shall provide a clean, well-defined 5/16 – inch width saw cut without damaging the adjacent area. The saw cut depth shall be 1-¾ inches. The

saw cuts shall be overlapped to provide full depth at all corners. All saw cuts requiring a right angle turnoff shall be cut at a diagonal to prevent sharp wire bends.

All cuts must be wired and sealed on the same day on which they are made. Loop installations shall not be made when the pavement is wet.

Vehicular traffic shall not pass over an open cut unless the cut is covered by a protective panel.

Immediately after the cutting operation, and just prior to the installation of the wire, the saw cuts shall be checked for the presence of jagged edges or protrusions; cleaned of all cutting dust, grit, oil and other contaminants; flushed by means of water stream; and cleared of water by means of an air stream. The blown air from the compressor shall be free of oil and water.

Care should be taken during the cleaning of the cuts to avoid blowing debris at passing pedestrians and motorists. It is imperative that the saw cut be clean and free of water before the wire installation proceeds.

Loop wires shall be installed from the hand box thru the turn in the loop cuts and back to the handbox in one continuous length, without in-line splices. The loop lead-in wires shall be twisted to provide a minimum of five (5) turns per foot from loop to pull box.

A minimum of thirty (30) feet of lead-in pair slack shall be coiled and left in the pull box for each loop. The wires for each detector shall be color coded for ease of identification of the separate loops.

The wire shall be type THHN #14 AWG minimum, stranded single conductor. All wire installations must be made without kinks, curls or other damage to the wire or its insulation. The Contractor shall replace any damaged wires at his expense.

The wire shall be installed as far down in the cut as possible. A blunt object, similar to a wooden paint stirrer, shall be used to seat the loop wire. In no case shall a screwdriver or other sharp tool be used for this purpose. The wire shall be held in place in the cut during installation by means of hold down strips. The hold down strips shall be approximately two (2) inches in length and placed approximately every two (2) feet. These strips shall be left in the cuts during pouring of the sealant. The strips shall be polyethylene foam sealant backers similar to Dow Chemicals Co. Ethafoam SB, or approved equal.

Prior to pouring the sealant, the loop detector shall be checked for continuity and resistance. In addition, the integrity of the installation shall be checked by applying a 1000 volts megger between each end of the loop lead-in and the nearest reliable electrical ground (e.g., streetlight, fire hydrant, etc.). In the event that no available ground exists, a suitable ground shall be established for the measurement (e.g., driven metal spike). The megger reading shall be in excess of 10 megohms under any condition. The inductance shall be between 60 and 100 microhenries.

The Contractor shall record the location and megger readings, and indicate satisfactory compliance with continuity check. Reading and test equipment data shall be submitted for the record. The Contractor shall utilize loop detector slot sealant as

per 822.11. The sealant shall not react with the cable insulation or adjacent pavement so as to create deterioration to these products.

The sealant shall be poured over the wire, half filling both the loop and lead in cuts. A check shall be made for air bubbles or material pile up and then the cuts are filled to roadway level. Excess sealant shall be removed by means of a squeegee. In all cases, there shall be neither a trough nor a mound formed.

The sealant when poured into a saw cut, shall completely surround the wires, displace all air in the cut and completely fill the area of the cut, except for that portion filled with the wire hold down material.

The Contractor shall allow sufficient time for the sealant to harden to accordance with manufacturer's instructions (minimum of two hours) before allowing traffic to move over the area unless it is covered by a protective panel. The Chief Engineer will determine when the hardening is acceptable.

The Contractor shall complete the loop detector installation by splicing in the hand box the loop detector cable with the loop detector lead-in cable. The splice kit used by the Contractor shall create a waterproof splice totally encapsulating all conductors. The Contractor shall maintain at least 3 feet of slack cable in both wires after splicing is completed.

Before leaving the site, the Contractor shall repeat the entire resistance and continuity test specified above. The report should be given to the Chief Engineer for comparison with the first report, and shall show no appreciable change.

- (B) MEASURE AND PAYMENT.** The unit of measure for Inductive Loop Detectors will be the linear foot of saw cut, excluding diagonal cuts to facilitate wire installation. The measure will include lead-in cuts to the face of curb. Payment will be made at the contract unit price for Inductive Loop Detectors. Payment will include all labor, materials, equipment and incidentals necessary complete the work specified herein.

### 617.15 MICROWAVE VEHICLE DETECTOR

- (A) DESCRIPTION.** The work consists of providing Microwave Vehicle Detectors at the locations indicated in the contract documents. The work also consists of providing a microwave detector isolation module for each Microwave Vehicle Detector with 12 VAC output conforming to this specification and the 2007 Supplemental Specification.

The Contractor shall drill a hole in the pole at the point designated in the contract documents where the microwave vehicle detector is to be mounted. Typically, microwave detectors are mounted as high as possible on the designated pole. The hole shall be approximately one inch in diameter and of such size that the microwave vehicle detector completely covers the entire hole. The edges shall be machined to remove burrs that may snag the cable.

The Contractor shall pull the 4 conductor 18 AWG lead-in cable through the hole and make electrical connections with the appropriate conductors to the terminal block of the microwave vehicle detector.

After the cable is attached, the microwave vehicle detector shall be affixed to the metal pole utilizing one inch wide stainless steel banding strapping at two points on the

microwave vehicle detector, one above and one below the device. The Contractor shall apply a continuous bead of waterproof sealant around the microwave vehicle detector at the pole to preclude the flow of moisture and debris to the back of the detector.

The Contractor shall aim the microwave vehicle detector to point in the precisely desired direction, as instructed by the Chief Engineer. After proper orientation is obtained, the unit shall be secured to maintain the desired orientation according to manufacturer's specifications.

The Contractor shall install the microwave detection isolation module with 12 AC Output into the appropriate rack on the controller cabinet and make proper electrical connections.

The Contractor shall ensure that the pole mounted detector and the isolation module perform satisfactorily. After the traffic signal is energized and placed into service, the Contractor shall troubleshoot the system and fine tune the detector to produce the desired level of detection, as directed by the Chief Engineer.

- (B) MEASURE AND PAYMENT.** The unit of measure for Microwave Vehicle Detector with the microwave detector isolation module with 12 VAC output will be each. Payment will be made at the contract unit price for Microwave Vehicle Detector complete in place. The price will include the equipment, pole mounting hardware, and all labor, equipment, materials and incidentals required to install the equipment, make electrical connections and fine tune the detector to the satisfaction of the Chief Engineer.

#### **617.16 TRAFFIC SIGNAL CONTROLLER AND CABINET**

- (A) DESCRIPTION.** The work consists of providing Traffic Signal Controllers and Cabinets at locations indicated in the contract documents. Traffic Signal Controllers and Cabinets shall conform to the requirements of the 2007 Supplemental Specification, sections 2007-TS-001 thru 2007-TS-004. Individual plans specific to each intersection and the traffic signal system will specify the type of cabinet and physical orientation of the cabinet.

The Contractor shall furnish all necessary labor, equipment, and materials to procure and install the controller and cabinet. Individuals tasked with wiring the cabinet must possess at least IMSA Level 2 certification and experience in working with the 170E type controller. No other Contractor employee will be permitted access to the cabinet or electronic components within the cabinet.

##### **1. Specifications**

The technical specifications for the Type 170E Traffic Signal Controller, the Module 336-SS Controller Cabinet, and all peripheral electronic components within the cabinet shall be as per the 2007 Supplemental Specification, sections 2007-TS-001 thru 2007-TS-004. The Contractor shall procure controller equipment in strict conformance with those specifications. The Contractor must submit and the DDOT must approve catalogs cuts from individual vendors before procurement is undertaken.

##### **2. Procurement, Acceptance and Programming**

The Contractor shall accept delivery of the controller, cabinet, and component parts from the vendor and deliver to the Traffic Signal Construction Branch at the Rear of

1338 G Street S.E. DDOT technicians will inspect the delivered items and inform the Contractor of any deficiencies before DDOT accepts delivery of the controller.

DDOT technicians shall program the controller to operate the approved traffic signal sequence of operation required for the specific intersection. The technician shall remove all unused component parts from the controller and place them in inventory. The technicians will allow the programmed controller and cabinet assembly to operate properly without malfunction in the shop area for 72 consecutive hours before proclaiming the equipment suitable for field installation.

The Contractor will be notified to pick up the programmed controller and cabinet after the signal operation is properly programmed and the controller has run in the shop area. The Contractor will pick up the controller cabinet assembly from the Traffic Signal Construction Branch and deliver the equipment to the field job site for installation.

### 3. Field Installation Procedures

The Contractor shall set the controller cabinet assembly on the permanent foundation ensuring that the foundation anchor bolts penetrate the designated holes in the base of the cabinet. The Contractor shall ensure that the front and rear cabinet doors are oriented properly in accordance with instructions in the contract documents. The Contractor shall level the cabinet, if necessary, using stainless steel shims placed where appropriate between the base of the cabinet and the foundation. The Contractor shall utilize stainless steel washers and bolts to affix the leveled cabinet securely to the foundation. All four bolts shall be tightened to ensure a secure and stable fit on the concrete foundation.

The Contractor shall pull all cables through the conduits into the controller cabinet allowing a minimum of 10 feet of slack cable inside the cabinet. The Contractor shall attach an identifying, waterproof tag onto each cable identifying the specific field equipment being serviced by that particular cable run. The Contractor shall furnish and install a new No. 6 bare solid copper ground cable from the appropriate terminal in the controller cabinet to the ground rod extending above the top of the controller cabinet foundation.

The Contractor shall be responsible for scheduling and ensuring the completion of the installation of secondary electrical service cable into the controller cabinet by the Potomac Electric Power Company (PEPCO). The Contractor shall maintain constant communications with counterparts in PEPCO to ensure that PEPCO officials are apprised of the project schedule for the purpose of avoiding project delays attributable to secondary electrical service installation.

The Contractor shall terminate all traffic signal, electronic sign, school flasher, vehicular and pedestrian detector lead-in, closed circuit television, and communications cables at their appropriate place on the terminal block of the controller cabinet. The Contractor shall cut the cables pulled into the controller cabinet at the appropriate length, strip the conductors, and affix terminal lugs at the end of the conductors. All cables shall be dressed and arranged using cable ties in a neat, orderly manner in accordance with accepted industry standards.

The Contractor shall apply a generous quantity of duct seal into each conduit entering the cabinet to help regulate cabinet humidity and to impede the flow of moisture or other matter between the cabinet and the underground conduit/manhole network. The duct seal shall penetrate at least 4 inches into each conduit entering the cabinet and shall totally encapsulate the conduit and cables. The duct seal shall be installed after all cable is terminated and dressed.

The Contractor shall apply a generous bead of waterproof sealant inside and outside the controller cabinet at all points where the cabinet is in physical contact with the concrete controller cabinet foundation to preclude the flow of moisture and debris between the inside of the cabinet and the outside environment.

- (B) MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Controller and Cabinet will be each. Payment will be made at the contract unit price for Traffic Signal Controller and Cabinet. Payment will include the cost of the controller, cabinet and all peripheral electronic components and all required labor, equipment, tools, materials and incidentals necessary to install the cabinet in the field and render the traffic signal operational in accordance with the approved traffic signal sequence of operation. The cost associated with arranging and providing secondary electrical service to the cabinet will be paid under 618.41

#### **617.17 REMOVE AND ABANDON TRAFFIC SIGNAL CONTROLLER CABINET FOUNDATION**

- (A) DESCRIPTION.** The work consists of providing all labor, equipment, tools and materials necessary to remove and abandon traffic signal controller cabinet foundations.

The Contractor shall demolish and remove the foundation completely. The Contractor shall seal the conduit, remove the anchor bolts, and cut off the ground wire and ground rod. If the foundation is located within a tree space, the Contractor shall backfill the excavated area with approved material to grade. If the foundation is located within a paved area, the Contractor shall backfill with approved material to within 6 inches of grade and shall install a temporary asphalt patch. The Contractor may be directed to pave the foundation area with sidewalk material approved for the site. The paved area will be paid for under the appropriate items of work in the contract.

All materials removed shall become the property of the Contractor and will be disposed at no additional cost to the DDOT.

- (B) MEASURE AND PAYMENT.** The unit of measure for Remove and Abandon Traffic Signal Controller Cabinet Foundations will be each. Payment will be made at the contract unit price for each foundation removed. Payment will include all labor, equipment, tools, materials and all incidentals, including clean up at the job site, necessary to complete the work specified herein.

#### **617.18 REMOVE TRAFFIC SIGNAL POLES AND TRAFFIC SIGNAL EQUIPMENT**

- (A) DESCRIPTION.** The Contractor shall provide all labor, materials, and equipment necessary for Remove Traffic Signal Poles and Traffic Signal Equipment. The work will include, and be limited to the following: metal traffic signal poles, transformer bases,

mast arms, vehicle and pedestrian signal heads, pedestrian push buttons, microwave vehicle detectors, electronic signs, cables, and other equipment related to the traffic signal plant. Work shall not begin until the replacement traffic signal is in service and operational, and until electrical service has been provided to the proposed signal controller and disconnected from the existing signal controller. The Chief Engineer must be satisfied that the proposed signal controller is operating with the approved traffic signal sequence of operation before existing equipment can be removed.

The Contractor shall remove all existing traffic and pedestrian signal heads, pedestrian push buttons, microwave vehicle detectors and other devices hanging on the pole and return them to the District Department of Transportation (DDOT). Care shall be taken to avoid damaging these devices, as they can be reused. The Contractor shall also remove all mounting hardware except stainless steel banding and return these items to DDOT.

The Contractor shall remove the existing traffic signal poles and 8 foot long mast arms and return these items to the DDOT. Poles and mast arms deemed by the Chief Engineer to be reusable shall be cleaned and painted before storage.

Static metal signs shall be removed from poles only after the Contractor has installed new replacement signs on the new poles.

Traffic signal equipment mounted on street light poles will be removed under this specification.

The Contractor shall remove all electrical cable between the previous controller cabinet foundation and each signal device. All cable is to be removed and discarded by the Contractor.

The Contractor shall clean up the area and ensure that all remnants of the former traffic signal including miscellaneous hardware are removed from the site.

- (B) MEASURE AND PAYMENT.** The unit of measure will be the Job. Payment will be made at the contract unit price without regard for the amount of materials to be removed from the intersection. Payment will include all labor, equipment, tools, materials, and all incidentals, including clean up at the job site and transportation of parts, necessary to complete the work specified herein.

#### **617.19 REMOVE TRAFFIC SIGNAL CONTROLLER AND CABINET**

- (A) DESCRIPTION.** The Contractor shall provide all labor, materials, and equipment necessary to remove the existing traffic signal controller and cabinet from the site. Work will not begin until the replacement controller is in service and operational and until power has been disconnected from the existing controller. No work will be performed until the Chief Engineer is satisfied that the proposed controller is satisfactorily operating with the approved traffic signal sequence of operation.

The Contractor shall carefully disconnect all field and communications cables from the cabinet, taking care to avoid damage to any part of the cabinet. Set screws in the terminal block shall be tightened. The Contractor shall disconnect the foundation bolts and lift the complete cabinet off the foundation and onto a vehicle suitable for transporting the

cabinet safely and securely back to the DDOT. The Contractor shall transport the entire cabinet to a facility designated by the Chief Engineer.

The Contractor shall clean up the area around the old cabinet foundation to ensure that all remnants of the old controller and cabinet including miscellaneous wire and hardware are removed from the site.

- (B) MEASURE AND PAYMENT.** The unit of measure for Remove Traffic Signal Controller and Cabinet will be each. Payment will be made at the contract unit price for each controller and cabinet removed. Payment will include all labor, equipment, tools, materials and incidentals, including clean up at the job site and transportation of the cabinet, necessary to complete the work specified herein.

### **617.20 REMOVE EXISTING SIGNAL HEAD**

- (A) GENERAL.** The Contractor shall be required to remove signal heads conforming to one of the following characteristics:

1. 1 Section pedestrian signal heads featuring the DON'T WALK and the WALK message in the same section.
2. 3, 4, or 5 Section vehicle signal heads featuring one or more sections with 8 inch diameter lenses.
3. 3, 4, or 5 Section vehicle signal heads with all lenses 12", but the signal head is determined to be damaged beyond repair and incapable of accepting an LED Module. Potentially damaged signal heads will be identified by the Contractor and verified by the District of Columbia inspector before removal and subsequent replacement is undertaken.
4. 3, 4 or 5 Section vehicle signal heads with all lenses 12" featuring one or more indications for a left turn or right turn movement considered redundant to the primary left turn signal so as to achieve compliance with the Manual on Uniform Traffic Control Devices by displaying only one indication for the non-primary movement. The District will identify these for the Contractor prior to issuance of the Notice to Proceed.
5. 1 Section yellow beacons used for flashing warning signals with 8" lenses.
6. 1 Section yellow beacons used for flashing warning devices with 12" lenses, damaged beyond repair and incapable of accepting an LED Module or identified for replacement.

The Contractor shall disconnect internal wiring at the terminal block of the signal head after identifying the function of each conductor to ease subsequent reinstallation. The end of each conductor shall be taped to avoid accidental contact with a metallic surface during the removal and reinstallation processes. On pole mounted signal heads, the Contractor shall cut the banding material or disassemble the mounting brackets to detach the signal head, upper and lower mounting brackets, universal pole plate and banding material/brackets from the pole. On mast arm mounted signal heads, the Contractor shall cut the banding material and detach the bracket, banding material, and signal head from the mast arm. The Contractor shall route the existing cable carefully through and free of the signal head assembly. At

the conclusion of the removal process, only the cable shall remain protruding through the hole in the pole or mast arm.

For the purpose of this pay item, no distinction shall be made by number of signal sections in the signal head, mounting arrangement or type of mount. All materials removed from the pole or mast arm shall be discarded by the Contractor.

Under no circumstances will a Contractor perform any work on optically programmable vehicular or pedestrian signal heads.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Remove Existing Signal Head will be each. Payment will be made at the contract unit price per each signal head removed and payment will include all labor, equipment, tools, materials and all incidentals necessary to complete the work.

#### **617.21 TRAFFIC SIGNAL REMOVAL, TEMPORARY INSTALLATION AND REINSTALLATION**

- (A) **GENERAL.** The Contractor shall remove the existing traffic signal equipment, traffic signal heads, pedestrian signals and mast arms located on streetlight poles or traffic signal poles that are to be removed and new foundations poured and poles installed. The Contractor will notify The DDOT Traffic Signal Engineer, (202) 671-2700, 48 hours in advance of removing and reinstalling traffic signals. The existing traffic signal heads shall be used for the temporary signals. The signal heads shall be mounted at the same height and oriented in the same direction as the existing signal heads removed from the pole. The signal heads will be installed on a 20 foot traffic signal pole and transformer base provided as part of this work. When the Contractor installs the new streetlight poles, the temporary poles and signals will be removed. The Contractor shall make and break all connections in the signal heads. DDOT Traffic Signal Technicians shall remove and install cable connections at the controller. All damage to the signal heads, cables or mounting hardware shall be repaired or replaced as directed by the Project Chief Engineer at no additional cost to the District of Columbia. Temporary Traffic Signal Foundation will be paid under item 618 27.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Traffic Signal Removal, Temporary Installation and Reinstallation will be each. Payment will be made at the contract price per each streetlight pole /traffic signal pole on a temporary foundation and all traffic required signal equipment on the pole, and payment will include all labor, equipment, tools, materials and all incidentals necessary to complete. The temporary foundations will be paid under 617.22.

#### **617.22 PORTABLE TRAFFIC SIGNAL BASES**

- (A) **DESCRIPTION.** Work consists of furnishing, maintaining and moving portable concrete traffic signal bases, where required, for traffic signals within the limits of work. A 4-foot by 4-foot by 1-foot deep concrete type base shall be provided, unless otherwise approved by the Chief Engineer. The work also includes providing a length of 3" liquid-tight flexible orange non-metallic conduit 50 feet long for each portable traffic signal base. Work also includes removal of the bases from the job site when no longer required.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Portable Traffic Signal Bases will be each. The total number of bases shall be the maximum number required and used in any one phase of construction. Payment will be made at the contract bid price per each. This payment shall include furnishing, maintaining (at no additional cost to the District) and removal of all required Portable Traffic Signal Bases on the project.

**617.23 FURNISH AND INSTALL ROUND STEEL MONOTUBE WITH ROUND STEEL MONOTUBE ARM**

- (A) **DESCRIPTION.** The Contractor shall furnish a round steel monotube pole with round steel monotube arm consistent with the dimensions specified in the contract documents and plans, and satisfying the technical specifications described on Standard Drawing No. 617.01. The pole and arm are to be fabricated from 11-gauge steel meeting the requirements of ASTM-A595 Grade A with a yield point of not less than 55,000 psi. The pole and arm are to be hot-dipped galvanized to the requirements of either ASTM A123 or ASTM A153. The final galvanized coating will be free of any debris or flux ash.

All holes necessary to allow for cable entry into signal heads, pedestrian and vehicle detection equipment or any other traffic feature shall be drilled and finished smooth prior to the erection of the pole on the foundation. All holes must be made prior to the entry of any cable into the pole, and burrs must be removed and made smooth to avoid snagging and subsequently damaging electrical cable as it is pulled through the hole.

The Contractor shall erect the pole on a leveled and true foundation with the holes in the base coinciding with the anchor bolts protruding from the foundation. The monotube mast arm shall be oriented perpendicular to the face of the adjacent curb or at a specific angle as shown on the plans or as directed by the Engineer. The Contractor shall supply sufficient torque to ensure a secure, stable connection between the pole base and the anchor bolts protruding from the foundation. The pole shall feature a 0.5 inch-13 tapped lug in the frame to accept the ground wire coming from the ground rod in the nearest manhole or handbox. The Contractor shall have the option of routing cable for signal heads and detection equipment through the pole and arm before they are erected, or providing a means for installing electrical cable without splices or damage after the pole is erected. After the bolts have been secured and tightened, the Contractor shall install the removable end cap at the end of the monotube arm and the cast aluminum pole top at the top of the monotube pole with stainless steel set screws. The Contractor shall apply a bead of sealant around the base of the pole to prevent moisture and debris from entering the pole between the top of the foundation and the bottom of the pole. The Contractor shall be responsible for the removal and disposal of all debris from the work site at the conclusion of the job.

- (B) **MEASURE AND PAYMENT.** The unit of measure for the Round Steel Monotube Pole With Steel Monotube Arm will be each. The payment for Round Steel Monotube Pole With Steel Monotube Arm will be paid at the contract unit price for each pole/arm assembly complete in place. The price will include all labor, equipment, tools, materials, clean up and incidentals to complete the work as specified.

**617.24 FURNISH AND INSTALL FOUNDATION FOR TRAFFIC SIGNAL POLE WITH MONOTUBE MAST ARM**

- (A) **DESCRIPTION.** The Contractor shall furnish all labor, equipment and materials necessary to construct a foundation for a traffic signal pole with a monotube mast arm, as shown on the contract documents and plans, in conformance with Standard Drawing Number 617.02. The length of the round steel monotube mast arm shall determine whether the Contractor constructs the foundation for mast arms up to 20 feet in length or greater than 20 feet in length. PCC concrete for the foundation shall conform to 817.03 (A) Class F.

The distance from the face of the curb to the center line of the foundation shall not be less than 36 inches or as noted on the contract documents. The Contractor shall excavate soil to the required depth and diameter to ensure that concrete is placed against undisturbed soil. Forms shall be true to line and grade. Conduit ends and anchor bolts shall be placed in proper position and shall be held in place by means of a template until the concrete sets. The foundation shall have two (2) Schedule 40 PVC conduits installed. One 2-inch diameter and one 4-inch diameter conduit shall be routed from the foundation toward the manhole(s) designated in the contract documents. The conduits shall extend above the top of the foundation at the distance range specified in the Standard Drawing No. 617.02. Each conduit installed to accommodate electrical cable shall feature a sweep radius of 39 inches so as to meet underground electrical conduit at the proper elevation below grade.

The four anchor bolts shall be set at the correct location to form the bolt pattern consistent with the requirements of Standard Drawing No. 617.01. The anchor bolt diameter, length, and bolt pattern varies according to the arm spread and is detailed on Standard Drawing No. 617.01. Each anchor bolt shall protrude above the top of the foundation at a distance range specified in Standard Drawing No. 617.02, shall be threaded at the top for a distance of 9 inches and shall feature a 6 inch L-bend at the bottom. Anchor bolts shall be in conformance with 822.06(B). Anchor bolts shall be aligned to ensure that the monotube mast arm is oriented perpendicular to the adjacent face of curb or at a specific angle as shown on the plans or as directed by the Engineer. The foundation shall be allowed to set for a minimum of 3 days before affixing pole hardware. All excavated materials and other construction debris shall become the property of the Contractor and shall be disposed of at no additional cost to the District.

A 0.75-inch diameter copper clad ground rod, a No. 6 solid copper ground wire, and heavy-duty ground clamps shall also be included. The ground rod and the ground clamp are not to be installed within the foundations; they are to be installed as prescribed in the Grounding Notes For Mast Arm Foundations, as detailed in Standard Drawing No. 617.02. The ground wire shall extend from the ground rod through the electrical conduit to the tapped ground lug on the pole.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Foundation For Traffic Signal Pole With Monotube Mast Arm will be each. The payment for Foundation For Traffic Signal Pole with Monotube Mast Arm will be at the contract unit cost for each foundation and will include excavation, PCC concrete, anchor bolts with hex nuts, ground rod, reinforcing steel, heavy duty ground clamps, No. 6 solid copper ground wire, grout, and Schedule 40 electrical conduits with the entire 36 inch sweep where appropriate. The payment will also include all labor, materials, equipment and incidentals necessary to complete the work specified herein and to completely clean all debris from the site.

## 618 STREET LIGHTING

**618.01 DESCRIPTION.** Street lighting work shall consist of furnishing all labor, equipment and materials and installing all electrical equipment, conduits, manholes, pull boxes, wiring, luminaires, fixtures, streetlight poles, and incidentals as shown in the contract documents, and as specified herein for a complete working streetlight system.

Wherever the word “provide” is used, it shall mean “furnish and install complete in place and ready for use.”

Definitions of electrical terms used in roadway lighting shall be in accordance with Appendix F of the American National Standard Practice for Roadway Lighting ANSI D12.1. Exceptions are as follows:

1. A luminaire shall include direct appurtenances such as a reflector, refractor, housing and supports that are integral with the housing, and high intensity discharge (HID) ballasts.
2. A light pole, also called a lighting standard, shall be considered to include anchor or transformer base, shaft, bracket arm if required, pole cable, and integral hardware to support luminaires.

Items for streetlight equipment shall consist of products of the same manufacturer, as far as practicable. The streetlight system shall conform as to voltage, amperage, frequency, and type specified.

In order to provide the proposed lighting system the Contractor shall cooperate with PEPCO. PEPCO will supply the power required for the locations outlined in the contract documents.

### 618.02 CODES AND STANDARDS

Material, equipment and installation shall conform to the following:

American Society for Testing and Materials (ASTM)

American National Standards Institute (ANSI)

Certified Ballast Manufacturers

Institute of Electrical and Electronic Engineers (IEEE)

Insulated Power Cable Engineers Association (IPCEA)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

Underwriters Laboratories, Inc. (UL)

District of Columbia Electrical Code

National Electric Safety Code

United States of America Standards Institute (USASI)

Rules and Regulations of the Potomac Electric Power Company (PEPCO)

American Association of State Highway and Transportation Officials (AASHTO)

Electrical contractors must be bonded in the District and their electricians must have District licenses. The Contractor must secure a permit approved by the Electrical Engineer, D.C., prior to the beginning of any work, and the street lighting work must at all times be inspected by electrical inspectors of the Department of Transportation (DDOT).

No work shall be covered or enclosed at any time prior to inspection.

The Contractor must have approved shop drawings, catalog cuts, and specifications available at the jobsite for inspection by the Chief Engineer and the Department's electrical inspector.

### 618.03 MATERIALS

- (A) **GENERAL.** New first quality materials shall be furnished in conformance with 820. Material and equipment must be UL listed and labeled. All electrical parts, wire, and other elements of the streetlight installations shall be of ample capacity to carry required current without excessive heating or causing an excessive drop in potential. Except as otherwise provided herein, each individual item of streetlight equipment shall bear a nameplate or other type of indelible marking or brand that shall identify it as to type, catalog number, and manufacturer. This applies to hardware and miscellaneous materials.
- (B) **COORDINATION WITH OTHER TRADES.** It shall be the responsibility of the Contractor to coordinate the location of equipment, conduit, devices, fixtures, etc., furnished and installed under other sections and by other trades to the extent that interference among such items is avoided. Relocation of items required as a result of failure of the Contractor to coordinate his work with the work of other trades shall be at the expense of the Contractor and at no additional cost to the District.
- (C) **STANDARD PRODUCTS.** Unless otherwise indicated, materials furnished shall be standard products of a manufacturer regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design complying with the specification requirements.

Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type, or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid. Specified materials shall be furnished unless changed by mutual agreement between the Contractor and the Chief Engineer. Where two or more designations are listed, the choice shall be optional with the Contractor.

Should the Contractor propose to furnish materials and equipment other than those specified, as permitted by the "or approved equivalent" clauses, he shall submit a written request for any or all substitutions to the Chief Engineer and must demonstrate that the equivalent product being submitted is equal to or exceeds all technical performance and visual criteria of the original specified item. Where such substitutions alter the design or space requirements indicated in the contract documents, the Contractor shall include in

his request all items of cost for the revised design and construction including cost of all allied trades involved.

Acceptance of the proposed substitutions shall be subject to approval of the Chief Engineer. If requested by the Chief Engineer, the Contractor shall submit for inspection samples of both the specified and the proposed substitute items.

In all cases where substitutions are permitted, the Contractor shall bear any extra cost of evaluating the quality of the materials and equipment to be installed.

- (D) **SAMPLES.** When samples are required they shall be submitted to the Chief Engineer for approval within 8 weeks after award of contract or prior to start of work, properly marked for identification and free of expense to the District. The District reserves the right to mutilate or destroy any sample submitted when considered necessary for testing purposes. Samples not so mutilated or destroyed will be returned to the Contractor at his expense when no longer necessary for the performance of the contract.

The Contractor shall submit the following:

- (1) The name and manufacturer of the equipment he proposes to furnish.
  - (2) Such data and descriptive materials as may be necessary for the mechanical trades in connection with maintenance.
  - (3) All wiring or necessary diagrams and drawings for approval.
  - (4) Any additional samples if deemed necessary.
- (E) **MATERIAL AND WORKMANSHIP.** Installation work shall be in accordance with the contract documents. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired by the Contractor in a manner meeting the approval of the District without additional compensation.

The contract drawings indicate the extent and general arrangement of the conduit and wiring systems. If departures from the contract drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted as soon as possible to the District for approval. No departures shall be made without prior written approval.

The Contractor shall be responsible for all cutting and patching necessary for accomplishing the work. All such modified areas shall be left in as good repair as prior to the beginning of this work, at the expense of the Contractor and at no additional cost to the District. Cutting of structural members shall not be done without approval of the Chief Engineer.

Materials and items of work shall be as specified in 820 and in the contract documents.

- (F) **GUARANTY.** The Contractor shall guarantee all electrical work to be in accordance with contract requirements and free from defective or inferior materials, equipment, and workmanship for a period of 1 year from date of acceptance of the streetlight work.

If, within the guaranty period, the Department finds that guaranteed work needs to be repaired or changed because of the use of materials, equipment, or workmanship which are inferior, defective or not in accordance with the terms of the contract, DDOT shall so

inform the Contractor in writing and the Contractor shall promptly and without additional expense to the District: (1) Place in a satisfactory condition all such guaranteed work; (2) Make good all damage to equipment, the site, the structure, and/or related appurtenances, which is the result of such unsatisfactory guaranteed work; (3) Make good any work, materials, and equipment that are disturbed in fulfilling the guarantee.

Should the Contractor fail to proceed promptly in accordance with the guarantee, the District may cause such work to be done and the Contractor and the surety or sureties under the bond shall be jointly and severally liable for the cost of same.

#### **618.04 CONTRACT PLANS AND MANUFACTURER'S DRAWINGS**

- (A) **STREETLIGHT PLANS.** The contract documents indicate the general arrangements of the streetlight circuits and conduits and the locations of poles and manholes. The contract documents are intended to show and describe the work entirely. However, every item necessary to complete the work may not be specifically shown or described. Incidentals not shown or specified, but necessary for the proper operation of the streetlight system shall be included in the work. The Contractor shall be responsible for furnishing all materials for the installation, complete, so as to insure the successful operation of the streetlight system.
- (B) **MANUFACTURER'S DRAWINGS.** Manufacturer's drawings shall consist of all shop and installation drawings, catalogs, photometric curves, performance data, pole installation details, etc. The Contractor shall secure and/or prepare these drawings and submit them as required by 105.02 before purchasing materials or proceeding with construction. Shop drawings shall show complete details of construction for all portions of the work included. The Contractor shall check each drawing to insure conformance with the contract plans and specifications, and each drawing shall bear the Contractor's signature and certification. Drawings and data not clearly identified will be returned without approval to the Contractor.

Transmittals accompanying all shop drawings shall contain names and addresses of the Contractor, subcontractors, and suppliers. Project title, reference to prior actions on submissions and specification reference shall also be indicated.

#### **618.05 INSTALL ELECTRICAL MANHOLE**

- (A) **DESCRIPTION.** The work consists of providing precast concrete or cast-in-place manhole and cast iron frame and cover to provide access to electrical conduit as shown in the contract documents. The Contractor shall furnish all labor, tools, material and equipment necessary for excavation, shoring, de-watering, steel plating (necessary steel plating of the roadway for moving traffic as directed by the Chief Engineer), installation of pre-cast or cast in place manholes, back filling, compaction of fill, temporary patch and maintenance of the cuts until the permanent repairs are made as directed by the Chief Engineer.

The Contractor will verify the exact locations of manholes in the field. Construct the manhole with concrete meeting the specifications of 817.03 for Class B. Before installing the manhole, a 6 inch layer of crushed stone or washed gravel shall be installed, leveled

and compacted and covered with tar paper; after installation the paper shall be removed from the drain hole.

Construct cast-in-place manhole with forms, complete with centering cores and molds, to conform to shape, form, line, and grade required and maintain sufficiently rigid to prevent deformation under load. Make all joints leak-proof and arrange horizontally or vertically. Place forms on successive units for continuous surfaces and fit to accurate alignment, assuring a smooth completed surface, free from irregularities.

All reinforcing bars installed within the manhole structure shall be bonded together. All concrete shall be 4500 psi (28-day strength) mix. The concrete shall be vibrated so there shall be no voids or honeycombing. A pulling-in iron shall be installed opposite of each conduit entrance; cable racks shall be installed as directed by the Chief Engineer.

Provide a 2 inch diameter hole at one corner in the floor of the manhole centered 6 inches off each wall and drive a ¾-inch by 10-ft long copper-clad steel ground rod into earth as indicated in the standard drawings. In pre-cast manholes, the hole shall be provided as a knock-out or pre-drilled. Field drilling of the pre-cast manhole will not be allowed. Extend ground rod approximately 6 inches above finished manhole floor. After completion of manhole provide a ground loop of bare copper ground wire (No. 6 minimum or another size as specified in the contract documents) within manhole and bond to the ground rod by an exothermic weld.

Connect all conduit grounding bushings, cable supports, other metallic parts, splices, neutral wire and ground wire run with each feeder to ground loop. Reinforcing bars shall be of the size and configuration as specified in the standard drawings for the size of the manhole to be installed. Frame and cover shall be heavy-duty gray cast iron and conform to the details of the standard drawings, and conform to AASHTO M105 and M306. The word "DCSL-TS" in 1 inch letters is to be cast in the depression shown in the center of the top of the cover and to be flush with the surface of cover.

Manufacturers logo shall not appear on top of either frame or cover. The manhole frames shall be set to the required grade, in full bed of concrete mortar to make watertight connection. Unless otherwise indicated, install tops of manhole covers in unpaved areas approximately ½ inch above finished grade, and in paved areas install flush with finished surface of paving. All adjustment to the grade shall be made using a poured concrete collar. Brick shall not be used to make the final grade adjustment.

- (B) **MEASURE AND PAYMENT.** The unit of measure of electrical manhole with frame and cover will be per each. Payment will be made at the contract unit price per each for install electrical manhole. Payment will include all labor, tools, materials, equipment, excavate, shoring, de-watering, manhole complete with all racks and pulling-in iron frame and cover, back filling, compaction of backfill, temporary patching, maintenance of the cut until the permanent repairs are made, and all incidentals necessary to complete the work specified herein.

#### **618.06 REMOVE ELECTRICAL MANHOLE**

- (A) **DESCRIPTION.** The Contractor shall furnish all labor, materials and equipment necessary to remove existing manhole as shown in the contract documents or as directed

by the Chief Engineer. The Contractor shall remove the frame, cover, and manhole roof, walls and floor. All electrical conduits shall be sealed with cement before backfilling. The excavation shall be backfilled in 6-inch layers and compacted. Backfill material shall consist of suitable soils or granular material. Before removing manholes, the Contractor shall remove all streetlight conductors from other manholes. Refer to following procedures for removal of conductors.

Locate all underground conductors from another D.C. manhole or PEPCO manhole.

Disconnect power from PEPCO power source before removal of conductors.

Remove all underground light conductors from other D.C. manholes or PEPCO manholes.

The Contractor is responsible for notifying PEPCO to disconnect the existing service when removing the existing equipment, and re-establish the service when the new equipment has been installed. Coordination with PEPCO will be the responsibility of the Contractor. All material removed shall become the property of the Contractor and be disposed of off-site at no additional cost to the District. The manhole frame and cover shall be returned to the District when directed by the Chief Engineer. Included within this pay item is the temporary patching of the pavement area where the manhole was removed and maintenance of the patch until final repairs have been made.

- (B) **MEASURE AND PAYMENT.** The unit of measure for remove electric manhole will be for each manhole removed. Payment will be made at the contract unit price per each manhole removed, temporary patching, maintenance of the cut until the permanent repairs are made and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work as specified herein.

#### **618.07 INSTALL FRAME AND COVER FOR MANHOLE**

- (A) **DESCRIPTION.** Work consists of providing and installing new manhole frames and covers for existing D.C. manholes. The frame and cover shall be heavy-duty gray cast iron and conform to the details of the standard drawings, and to AASHTO M105 and M306. The word “**DCSL-TS**” in 1 inch letters is to be cast in the depression shown in the center of the top of the cover and to be flush with the surface of cover. Manufacturers logo shall not appear on top of either frame or cover. The manhole frames shall be set to the required grade, in full bed of concrete mortar to make watertight connection.

Unless otherwise indicated, install tops of manhole covers in unpaved areas approximately ½ inch above finished grade, and in paved areas install flush with finished surface of paving. All adjustment to the grade shall be made using a poured concrete collar. Brick shall not be used to make the final grade adjustment.

The new manhole frame shall be grounded to the manhole ground rod by approved methods.

The work also includes the removal of the frames and covers from the existing manholes as indicated in the contract documents.

- (B) **MEASURE AND PAYMENT.** The unit of measure for install electrical manhole frame and cover to existing electrical manhole will be each. Payment for install frame and cover

will be made at the contract unit price per each. The payment will include providing and installing the new frame and cover, adjusting frame and cover to new grade, and removal of the existing frame and cover, all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

#### **618.08 CLEANING ELECTRICAL MANHOLE**

- (A) **DESCRIPTION.** The work consists of the removal of all water, dust, and debris from existing manholes. Prior to the removal, the Contractor, using appropriate test procedures, shall determine the existence of hazardous waste within the manhole.

A positive test result for hazardous waste will require the Contractor to remove the hazardous wastes using approved appropriate procedures. The removal of the hazardous waste material will be as specified in Section 618.09.

- (B) **MEASURE AND PAYMENT.** The unit of measure for cleaning electric manholes will be each. Payment for cleaning electric manholes will be made at the contract unit price per each. The payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

#### **618.09 REMOVE HAZARDOUS WASTE MATERIALS FROM MANHOLE**

- (A) **DESCRIPTION.** Work consists of the removal of all hazardous wastes from the existing manholes using appropriate procedures. The Contractor shall submit the hazardous waste removal procedures to the Chief Engineer for approval and shall have the approval prior to proceeding with the hazardous waste removal

- (B) **MEASURE AND PAYMENT.** The unit of measure for Remove Hazardous Waste Materials From Manhole will be each. Payment will be made at the contract unit price per each manhole actually cleaned of hazardous wastes. The payment will include all labor, equipment, tools, materials and incidentals necessary to remove the hazardous waste from the manholes and from the job site to an approved hazardous waste facility, and complete the work as specified herein.

#### **618.10 REPAIR ELECTRICAL MANHOLE**

- (A) **DESCRIPTION.** The work consists of repairing existing District (D.C.) manholes after the manholes have been cleaned according to sections 618.08 and 618.09. The Contractor shall proceed with the repair work as follows.

1. Identify all damage in DC electrical manhole. Repair all damages in the manhole with non-shrink grout as specified in Section 703.
2. Remove existing conductors between manhole and other manholes and/or streetlights connected to the conductors designated by the Chief Engineer. Patch conduit holes in DC or PEPCO manholes. The existing conduits that contained the removed conductors shall be abandoned between manholes and between manholes and streetlights. The abandoned conduit ends shall be cut flush with the inside face of the manhole wall.

3. The abandoned conduit shall be filled with non-shrink grout meeting the requirements of Section 703 to a depth of 6 inches from the inside face of the manhole, and finished clean smooth with the inside wall of the manhole.

The Contractor shall be responsible for notifying PEPCO to disconnect the existing service prior to the removal of the existing equipment, and re-connection of the service after the new equipment has been installed. Coordination and scheduling with PEPCO shall be the responsibility of the Contractor.

- (B) **MEASURE AND PAYMENT.** The unit of measure for repair electric manholes will be each. Payment for repair electric manhole will be made at the contract unit price per each. The payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

#### 618.11 ELECTRICAL JUNCTION BOX

- (A) **DESCRIPTION.** Work consists of providing pre-cast junction boxes to provide access to electrical conduit as shown in the contract documents. The Contractor shall furnish all labor, tools, material and equipment necessary for excavation, shoring, de-watering, installation of junction boxes, back filling, compaction of fill, temporary patch and maintenance of the cuts until the permanent repairs are made. Steel plates may be required as directed by the Chief Engineer and will be paid as specified in Section 624.

The Contractor will verify the exact locations of junction boxes in the field and install per manufacturer's instructions.

In the 2 inch hole provided in the floor of the junction box, drive a ¾-inch by 10-ft long copper-clad steel ground rod into earth as indicated in the contract documents. Extend ground rod approximately 6 inches above junction box floor. After completion of junction box, provide a ground loop of bare copper ground wire (No. 6 minimum or another size as specified in the contract documents) within junction box and bond to the ground rod by an exothermic weld. Connect all conduit grounding bushings, cable supports, other metallic parts, splices, neutral wire and ground wire run with each feeder to ground loop.

The junction boxes shall conform to details indicated in the standard drawings. The word "DCSL-TS" in 1 inch letters is to be cast in the depression shown in the center of the top of the cover and to be flush with the surface of cover. Manufacturers' logo shall not appear on top of either frame or cover.

The junction box shall be set to the required grade. Provide a temporary patch around the junction box and maintain the patch until permanent repairs are made.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Electrical Junction Box will be each. Payment for Electrical Junction Box will be made at the contract unit price per each. The payment will include temporary patching and maintenance of the patch, and all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

**618.12 INSTALL ELECTRICAL CONDUITS (CONCRETE ENCASED)**

- (A) **DESCRIPTION.** Work consists of providing PVC conduit in the sizes and duct bank configurations shown in the contract documents. The conduit shall be encased in PCC dry pack meeting the requirements of Section 817.03 for Class F, 3500 psi concrete. The work also consists of the excavation, shoring, backfilling, and trench backfill compaction. Steel plating shall be required for a minimum of twenty-four (24) hours to protect the concrete before opening to traffic. Payment for steel plating shall be in accordance with 616.19.

The Contractor shall excavate the trench at the locations indicated in the contract drawings. The trench excavation and shoring shall be in accordance with 207.

Conduit(s) shall be PVC schedule 40 and the size and duct bank configuration specified in the contract documents, and shall be installed to proper line and grade. The trench shall be opened progressively between manholes or between manholes and the proposed streetlights, with simultaneously installation of conduit(s). Conduit(s) shall be installed with a minimum of 36 inches of cover in roadways and 24 inches in all other locations, and shall be installed in dry trenches. The conduit shall be installed in full lengths using manufactures' supplied bends and couplings. When the Contractor must make field cuts, the conduit ends shall be reamed to remove any rough edges before joining together. The joints shall be cleaned, cemented and the lengths of the conduits coupled tightly.

Where two or more conduits are being installed in the same trench, the Contractor shall use approved conduit spacers for the size and configuration of the conduit runs. Conduit(s) shall be installed to slope toward manhole. The slope of duct bank runs shall be at least 10 inches per 300 ft. All conduit runs shall be complete and points of penetration of the wall of the manholes shall be sealed before any dry mix concrete encasement is installed. The wall penetration of PEPCO manholes will be done under the supervision and direction of PEPCO field personnel. The penetration of DC manholes will be done under the supervision and direction of the District personnel. At the end of each workday, the Contractor shall seal the ends of all conduits to prevent the entrance of dirt and water into the conduit system.

The Contractor shall provide 4" detectable magnetic plastic warning tapes 12" above the top of the concrete encasement of the duct banks as shown in the contract drawings. The warning tape shall be detectable by means of sensors in use to detect buried cable and conduit. The color of warning tape shall be yellow. The warning on the tape will be **"CAUTION, BURIED ELECTRICAL LINE BELOW"**.

The backfilling of the trench shall be in accordance of the provisions of 207.04.

New conduit may be spliced or added to existing conduit as a part of this work. The splice shall be accomplished with couplings approved for the size of the conduits. The Contractor shall locate all underground utilities and underground structures prior to trenching.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Install Electrical Conduit (Concrete Encased) will be per linear foot of conduit or duct bank of conduits installed. Payment will be made at the contract unit price per linear foot. The payment will include all labor, tools, materials, equipment, excavation, shoring, de-watering, concrete

encasement, penetration of manholes (District-owned), back filling, compaction of fill, temporary patching, maintenance of the cut until the permanent repairs are made, and all incidentals necessary to complete the work specified herein. Steel plating shall be paid for according to 616.19.

### **618.13 INSTALL ELECTRICAL CONDUITS (BORED)**

- (A) **DESCRIPTION.** The work consists of the installation of conduit by the method of directional boring. The Contractor shall furnish all labor, tools, material and equipment necessary for directional boring, also referred to as Horizontal Directional Drilling (HDD) to install conduit at the locations shown in the contract documents. All conduit placed under existing pavement shall be installed with no disturbance to the existing roadway. Any damage to the existing pavement shall be repaired at the direction of the Chief Engineer at no cost to the District.
- (B) **CONSTRUCTION REQUIREMENTS.** The Contractor shall drill to pull in the conduits in the size specified in the plans Conduit(s) shall be PVC schedule 80 meeting the requirements of ASTM F789 and shall be installed to proper line and grade. Conduit(s) shall be installed with a minimum of 36 inches of cover in roadways and 24 inches in all other locations. The conduit shall be installed in full lengths using manufactures' supplied bends and couplings.

Conduit(s) shall be installed to slope toward manhole. The slope of duct bank runs shall be at least 10 inches per 300 ft. All conduit runs shall be complete and points of penetration of the wall of the manholes shall be sealed before any dry mix concrete encasement is installed. The wall penetration of PEPCO manholes will be done under the supervision and direction of PEPCO field personnel. The penetration of DC manholes will be done under the supervision and direction of the District personnel. At the end of each workday, the Contractor shall seal the ends of all conduits to prevent the entrance of dirt and water into the conduit system.

The Contractor shall locate any and all underground utilities and tunnels before trenching. Several locations in the District may have abandoned street-car tracks, covered with pavement. The Contractor shall verify and locate before trenching by means of test pits.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Install Electrical Conduits (Bored) will be per linear foot of conduit or duct of conduits installed by boring. Payment will be made at the contract unit price per linear foot. The payment will include all labor, tools, materials, equipment, excavation, boring, penetration of manholes (both D.C.'s & PEPCO's), and all incidentals necessary to complete the work specified herein.

### **618.14 ROD AND CLEAN DISTRICT-OWNED CONDUIT**

- (A) **GENERAL.** Work consists of providing all labor, equipment and materials necessary to rod and clean and prove the integrity of the existing electrical conduit between the manholes or between manholes and existing streetlight or traffic signal poles as required. If the conduit is found to be blocked, collapsed or have a breakdown during the rod-clean phase, the location must be determined and marked so the repair can be made to the duct

under 618.15. All material removed from the conduit as part of the cleaning operation shall be disposed of by the Contractor off site at no additional cost to the District.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Rod and Clean District Owned Conduit will be the linear foot. Payment will be made at the contract unit price per linear foot. The payment will include all labor, tools, material, equipment needed to rod and clean the existing conduit and all incidentals necessary to complete the work specified herein.

#### **618.15 REPAIR EXISTING DISTRICT-OWNED CONDUIT**

- (A) **GENERAL.** The work consists of repairing blocked, collapsed or a break-down in existing conduit discovered during the duct rod and clean phase, between the manholes or between manholes and existing streetlight or traffic signal poles.
- (B) **CONSTRUCTION REQUIREMENTS.** The Contractor shall excavate, shore and dewater the trench as necessary to expose the affected conduit. The Contractor shall make the repairs as needed to existing conduit and install concrete encasement around the repaired duct. Back filling, compaction of the fill, temporary patching and maintenance of the cuts until the permanent repairs are made shall be performed as directed by the Chief Engineer.
- (C) **MEASURE AND PAYMENT.** The unit of measure for Repair Existing District Owned Conduit will be the linear foot. Payment will be made at the contract unit price per linear foot of conduit. The payment will include all labor, tools, materials, equipment, excavation, concrete encasement, back fill, compaction of the fill, temporary patch of surface, maintenance of the cut until the permanent repairs are made and all incidentals necessary to complete the work specified herein.

#### **618.16 INSTALL ADDITIONAL CONDUIT AND SWEEP BENDS IN POLE FOUNDATION**

- (A) **DESCRIPTION.** The work consists of furnishing and installing additional conduits and sweep bends in pole foundations that will be necessary only in case of existing lead feeder cables. This is beyond the 1 conduit and sweep bend necessary for all foundation installation.

The Contractor shall furnish and install, and provide caps for up to 2 (two) additional conduit stubs (one to street, one to the sidewalk), each with a sweep bend, in pole foundation whenever there is a lead cable or as directed by the Chief Engineer.

Conduit(s) shall be PVC schedule 40 and the sweep bends shall be 24" radius.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Install Additional Conduit and Sweep Bends in Pole Foundation will be per each. Payment will be made at the contract unit price per linear foot of conduit and sweep bends. The payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

### **618.17 PROBE-DISCOVER FAULTS IN THE STREETLIGHTING CABLE/CONDUIT SYSTEM**

- (A) **GENERAL** The Contractor shall probe-discovery faults in Street lighting cable/conduit system, as shown in the contract documents or upon notification by the DDOT Street Light Branch, of a cable/conduit failure. Work shall proceed at each designated location, as follows:
1. DC Street Light Branch will provide the Contractor the access to the cable/conduit plats or GIS printout for each location that show the locations of the feeds between the PEPCO manholes, DC manholes or lights that are out. The plats/printouts are not guaranteed to be 100% accurate and the Contractor must verify field conditions.
  2. The Contractor shall determine if the feeder cable is direct-buried cable(s) installed in conduit, if the conduit system is blocked, broken down, gas pipe or a partial conduit system between the light pole and its feed source, and shall probe to locate and determine the problem using appropriate tools and testing equipment.
  3. If the problem is determined to be defective cable in the conduit or manhole, the Contractor shall proceed with the repair work under the appropriate pay items in this contract as directed by the Chief Engineer.
  4. If the problem is with the conduit system or direct burial cable, the Contractor shall proceed with the work under Pay Item, Developing Repair Procedures of Faults in the Street Lighting Cable/Conduit System.
- (B) **MEASURE AND PAYMENT.** The unit of measurement Probe-Discover Faults in the Streetlighting Cable/Conduit System will be per each location as directed by the Chief Engineer. Payment will be made for each location for all labor and equipment necessary to complete the work specified herein.

### **618.18 DEVELOP REPAIR PROCEDURES FOR FAULTS IN THE STREETLIGHTING CABLE/CONDUIT SYSTEM**

- (A) **GENERAL.** The Contractor shall, after the Probe-Discovery phase has been completed and if required, meet with the staff of the Streetlight Branch at each designated location to determine how the permanent repairs will be made to the fault. The work shall be as follows:
1. Coordinate a meeting with the Streetlight Branch staff on location or in their office to determine the course of action to correct the fault.
  2. Bring field notes or show findings from the Probe-Discovery Phase.
  3. Set out the procedures on how to correct the fault.
  4. Establish which pay items will be needed in the permanent repairs and estimated quantities to complete the repair.

Acquire verbal cut number; prepare permit application and drawings needed to perform the repair work. (Verbal cut number on this contract can be obtained by calling Investigations and Inspection Branch on (202) 645-7050.)

- (B) **MEASURE AND PAYMENT.** The unit of measurement for Develop Repair Procedures for Faults in the Streetlighting Cable/Conduit System will be per each location as directed by the Chief Engineer. Payment will be made for each location for all labor and equipment necessary to complete the work specified herein.

#### **618.19 DRAWINGS-PERMIT APPLICATION FOR REPAIR IN THE STREETLIGHTING SYSTEM**

- (A) **GENERAL.** The contract will act as the Public Space Permit to do all work given to the Contractor under this pay item. The drawings will be added to the contract as "AS-BUILD" conditions after the work is complete. The Contractor shall make the necessary permit drawings, showing locations of all cuts, conduit paths, submit drawings for approval to the Street Light Branch and complete the Public Space Permit Application. The Contractor for each designated locations will perform the following work:

Make necessary permit drawings of conduit runs, ensuring that all dimensions between the conduit and the face of the curbs are on the drawings.

1. Verbal cut numbers and all cuts are shown on the drawings with dimensions from the face of the curbs
  2. Fill out the Public Space Permit Application for each cut made.
  3. Deliver to the drawings to the Street Light Branch for approval and stamping for submission with the Public Space Permit Application.
  4. The Public Space Permit Application will be delivered to the Street Light Branch's office for the necessary agent's signature; the Street Light Branch staff will file the permit application.
- (B) **MEASURE AND PAYMENT.** No separate payment will be made. The work is measured and paid for under Pay Item Develop Repair Procedures for Faults in the Street Lighting Cable/Conduit System.

#### **618.20 INSTALL UNDERGROUND STREETLIGHT CABLES**

- (A) **GENERAL.** The work consists of furnishing all labor, materials and equipment necessary to install current carrying conductors, as specified in the contract document. The conductors will be installed in, but not be limited to, manholes, existing conduit, new conduit, transformer bases and poles.
- (B) **CONSTRUCTION REQUIREMENTS.** All cables shall be installed in continuous lengths and without splices between termination points. The Contractor shall provide adequate and proper equipment for the pulling in of the cables. The Contractor shall pull the cables through conduits without over-stressing, scoring or cutting the wire and without damaging the insulation or outer covering.

Where strain on the cables is likely to be excessive, the Contractor shall use an approved cable lubricant meeting the requirements of cable supplier. Where more than one cable is to occupy the same conduit, the cables shall be installed at the same time.

If the Contractor is not making the final splices or terminal connections immediately after installation, the cable ends shall be sealed to prevent moisture intrusion. The Contractor

shall install sufficient slack cable in each manhole to allow for racking. Each phase conductor and neutral shall be identified using standard color markings as indicated in 820.11.

All cables located in utility company (i.e., PEPCO) manholes shall be tagged to show ownership, circuit number and voltage. Cables in District-owned manholes shall be tagged to indicate phase. After cables have been spliced, racked, and prior to final service connection by the utility company, the Contractor shall give each phase conductor and neutral an insulation resistance test between the conductors and ground. The test shall be performed in the presence of the Chief Engineer.

The Contractor shall furnish all labor, materials and test equipment. The test equipment shall be calibrated and certified yearly by a testing laboratory or the equipment manufacturer. Copies of the certification shall be supplied to the Chief Engineer.

Each conductor shall indicate a value of not less than fifteen (15) mega ohms. If a fault exists, the Contractor shall locate the faulty cable section, and furnish and install a new cable. If it is determined that the fault is due to a splice, the decision to repair the splice or to replace the faulty cable section shall be determined by the Chief Engineer.

The Contractor is responsible for notifying PEPCO to reestablish the service when the new equipment has been installed. Coordination with PEPCO will be the responsibility of the Contractor.

**(C) MATERIALS.**

1. Cable – as per Section 820.11
2. Splices – as per Section 621.12
3. Circuit identification – as per Section 820.11

**(D) MEASURE AND PAYMENT.** The unit of measure for Install Underground Streetlight Cables will be per linear foot complete in place. Payment will be made at the contract unit price per linear foot of cable. The payment for installation will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work specified herein.

**618.21 INSTALL OVERHEAD CABLES**

- (A) GENERAL.** The work consists of providing overhead cables of the size specified in the contract documents to provide service to streetlights mounted on wood poles. The streetlights are normally mounted on district owned wood poles, but the installation may be on wood poles owned by other utilities.
- (B) CONSTRUCTION REQUIREMENTS.** The Contractor shall install the overhead cable using approved connection hardware and approved equipment. The Contractor shall ensure that the cable is not damaged during installation. The cable shall be installed according to the cable manufacturer's specifications. The cable shall be installed with proper tension and sag according to the temperature on the day installed. All damaged cables will be removed from the site and replaced at no additional cost to the District.

The overhead cable shall be a certified neutral supported cable of the size specified in the contract documents.

Tree branches or tree limbs that prevent the installation or are within the cable clearance area shall be pruned or removed at the direction of the Chief Engineer. Qualified line clearance tree trimmers will perform all pruning work. Tree branches, tree limbs and any other debris generated shall be removed from the project site and properly disposed of as a part of this work.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Install Overhead Cables will be per linear foot. Payment will be made at the contract unit price per linear foot of cable. The payment for installation will include all labor, equipment, tools, materials (including approved hardware for connections), and all incidentals (including splices) necessary to complete the work specified herein

#### **618.22 INSTALL COPPER GROUND WIRE**

- (A) **GENERAL.** The work consists of providing copper ground wire in conjunction with current carrying conductors as indicated in the contract documents. The installation of copper ground wire may include the replacement of existing damaged copper ground wire as directed by the Chief Engineer.
- (B) **CONSTRUCTION REQUIREMENTS.** The Contractor shall install the ground wire in continuous lengths. All connections in manholes shall be made using exothermic welds with two coats of insulating varnish applied over welds and the ground wire within 1 foot of the weld. All connections to foundation ground rods shall be made with approved connectors. Grounding conductors shall be sized according to Section 250, National Electrical Code. The ground wire shall be installed simultaneously with current carrying conductors. The Contractor shall ensure that the ground wire is not damaged or kinked during installation. All damaged wire shall be removed and replaced at no additional cost to the District. The grounding system shall be installed, connected and tested before energizing the current carrying conductors.
- (C) **MEASURE AND PAYMENT.** The unit of measure for Install Copper Ground Wire will be per linear foot. Payment will be made at the contract unit price per linear foot of cable complete in place. The payment for installation will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work specified herein.

#### **618.23 REMOVE UNDERGROUND CABLE**

- (A) **GENERAL.** The work consists of the removal and disposal of underground District owned cables, conductors and ground wire, as indicated in the contract documents, or as directed by the Chief Engineer. The work includes cable in ducts and direct buried cables.
- (B) **REMOVAL PROCEDURES.** The Contractor shall ensure that when the cable is removed, no remnants of the cables remain in the duct.

The Contactor shall remove the designated underground alley light or streetlight cables between DCSL/TS manholes or PEPCO manholes; between PEPCO manhole and DCSL/TS manhole; or between DCSL/TS manhole and DC manhole, according to following procedures:

1. Locate power source of each alley light or streetlight circuit.
2. Disconnect the power before removal of cables between manholes.
3. Remove all underground cables between manholes or light and manhole.

The Contractor shall be responsible for notifying PEPSCO, if PEPSCO manholes are a part of this work, to disconnect the existing service when removing the existing cable, and to reestablish the service when the new cable has been installed. All coordination with PEPSCO for this work will be the responsibility of the Contractor.

Lead jacketed or lead insulated cables shall be disposed of in the manner prescribed for hazardous waste. The disposal shall meet District and Federal environmental regulations. The area around each manhole entrance shall also be cleaned of all hazardous waste and debris before the Contractor leaves the site. The Contractor will dispose of all debris and hazardous waste generated as part of the work at no additional cost to the District.

In ducts or trenches where more than one cable is to be removed, the Contractor shall be paid for the linear foot of one (1) cable, not all removed cable.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Remove Underground Cable will be per linear foot. Payment will be made at the contract unit price per linear foot of cable. When multiple cables are to be removed from a single duct, all removed cables will be considered as one (1) cable for payment. The payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work specified herein.

#### **618.24 REMOVE EXPOSED RACEWAY ON WOOD POLE**

- (A) **DESCRIPTION.** The Contractor shall identify wood poles or investigate wood poles as identified in the contract documents with raceways that protect alley light conductors from manholes. Remove raceways after removal of existing feeders as per 618.23.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Remove Exposed Raceway on Wood Pole will be made at the contract unit price per each raceway removed. Payment will be made at the contract unit price per each raceway. The payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

#### **618.25 INSTALL FOUNDATION FOR STREETLIGHT POLES**

- (A) **DESCRIPTION.** The work consists of furnishing and installing streetlight pole foundations at the locations specified in the contract documents. The Contractor shall install the number and size of the conduits and sweep bends in the foundations specified in the contract documents as part of this work.
- (B) **CONSTRUCTION REQUIREMENTS.** The foundation shall be cast in place at the locations specified in the contract documents and centerline of the foundation will be located 36 inches from the face of the curb unless otherwise indicated in the contract documents. The foundation shall not be installed at locations where the minimum clear area on a sidewalk will be less than 36 inches. A one (1) inch conduit shall be installed

through the foundation for the installation of a ground rod. The ground rod and connection shall be included in the as a part of this work.

The Contractor shall be responsible for ensuring that all reinforcing steel, anchor bolts, ground rods, conduit and other appurtenances are properly located before concrete is poured. The anchor bolts shall be set to the bolt circle specified in the contract documents and shall project 3" above the top of foundation. Where existing conduit is reused it shall be connected with new PVC conduit going into the new foundation using approved electrical couplings. The conduit for the electrical conductors shall be set as close to the center of the foundation as possible. All foundation caps shall be set one inch above grade. The foundation shall be allowed to set for a minimum of 72 hours before installation of the pole.

The Contractor shall be responsible for the disposal off site of all excavated earth and debris resulting from this work at no additional cost to the District.

**(C) MATERIAL.**

1. PCC – Class B, as per 801.01 (A) and (B), AASHTO M85, Type I
2. Conduit – Schedule 40, as per 820.12, FS 1094A
3. Reinforcing steel – as per 812.02, AASHTO M 31, Grade 60
4. Anchor Bolts – as per 822.06, AASHTO M 314

**(D) MEASURE AND PAYMENT.** The unit of measure for Install Foundation for Streetlight Poles will be per each foundation installed. Payment will be made at the contract unit price per each foundation. The payment for installation will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work specified herein.

**618.26 REMOVE STREETLIGHT FOUNDATIONS**

**(A) GENERAL.** The work consists of the removal of streetlight pole foundations as shown in the contract documents. The Contractor shall remove the foundation completely. The Contractor shall cut and seal all conduit that is to remain in place, remove the anchor bolts, reinforcing steel, and the ground wire or rod.

Where the foundation is located within a tree space, the Contractor shall backfill the excavation with approved material to grade. Where the foundation is located in a paved area the contractor shall backfill with approved material to within 6" of grade and then install a temporary asphalt patch meeting the requirements of 407.

**(B) MEASURE AND PAYMENT.** The unit of measure for Remove Streetlight Foundation will be per each foundation removed. Payment will be made at the contract unit price per each foundation removed. The payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work specified herein.

**618.27 STREETLIGHT BASE – BREAKAWAY AND STEEL**

**(A) GENERAL.** The work consists of providing Breakaway and Steel Streetlight Bases at locations shown in the contract documents. The bases shall be provided with all necessary factory supplied hardware for the access door, installation, and grounding.

- (B) CONSTRUCTION REQUIREMENTS.** The Contractor shall install the base on the existing streetlight foundation. The base shall be trued and leveled by means of factory supplied shims. The base shall be grounded to the foundation by means of factory supplied lugs. The Contractor shall set the base with care so as not to damage the finish or cause deformation. All damage to the finish will be repaired and/or replaced at no additional cost to the District. If the material is damaged during the time between installation and acceptance by the District, the Contractor shall repair and/or replace in kind at no additional cost to the District.

Replace Streetlight Base at Existing Streetlight Pole.

Work includes, but is not limited to, replacing damaged and deteriorated streetlight pole transformer base with a new streetlight base. The Contractor shall disconnect service to the streetlight; temporarily remove the existing streetlight pole; remove the damaged or deteriorated base, install a new streetlight base on the new or existing foundation, and reinstall existing streetlight pole and equipment. The Contractor shall make all necessary splices, and ensure that the streetlight is operational.

- (B) MATERIAL.**

Breakaway Base – as per 820, ASTM A 356

Steel Base – as per 820, AASHTO M 111M/M

- (C) MEASURE AND PAYMENT.** The unit of measure will be per each Streetlight Base. Payment will be made at the contract unit price per each Streetlight Base. The payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work specified herein.

#### **618.28 INSTALL STREETLIGHT POLE**

- (A) GENERAL.** The Contractor shall provide new streetlight poles and arms as specified in the contract documents. (Transformer base installation for pendant posts shall be covered by a separate item). All accessories including bolts, bolt caps, nuts, washers and clips necessary for installation are included in the work. All equipment that the Contractor receives shall be stored according to manufacturer recommendations. The bases and shafts shall be installed true and level and any required shimming shall be done with factory-supplied shims.

The Contractor shall set the post with care so as not to damage the finish. All damage to the finish will be repaired and/or replaced at no additional cost to the District. The Contractor shall replace any material damaged before the acceptance by DDOT in kind at no additional cost to the District. All debris generated as part of the work will be disposed of by the Contractor at no additional cost to the District.

Feeder cable (#10 stranded wire RHW-2 or as specified in the contract documents) and ground (#8 or as specified in the contract document) cables associated with the pole installation shall be included in this bid item.

When directed by the Chief Engineer, the Contractor shall deliver new poles to DC Warehouse (located at 1735 Fenwick Street, N.E., Washington, DC 20002). The contractor should call 24 hours in advance of delivery of the required material. The

delivery time at the warehouse is 8:30-11:30 a.m. and 12:30-2:00 p.m. Monday through Friday.

#### **Pendant Pole with Eight Foot Arm**

Work includes provision of steel pendant pole with an eight (8) foot arm, or as specified in the contract documents. Included shall be all electrical wiring, power cable, and ground wires. Materials shall meet the requirements as specified in the contract documents.

#### **No. 16/18/716/Twin-20 Streetlight Pole**

Work shall include drilling or slotting newly installed base in order to install the pole on a new 15" bolt circle foundation. The Contractor shall install the pole plumb. If required, shimming shall be done only with manufacturer's supplied shims. The Contractor shall furnish new #16 casing and base doors, as a part of this pay item.

#### **5A Alley Post with 3-foot Arm**

Work shall include installation of post by direct embedment in the ground.. The Contractor shall install the post grounding system before installing any power cables. A ¾" x 10' ground rod shall be installed beside the post. The Contractor shall ground the post with a #8 stranded bare copper wire (or as specified in the contract documents) connected to the post grounding lug and to the ground rod with exothermic welds and covered with two coats of insulating varnish. When setting the post the Contractor shall use care so as not the damage the factory applied finish. Damage to the post shall be repaired by the Contractor at no additional cost to the District.

The poles shall not be installed on any property entrances. In case of conflicting dimensions in the contract documents, the Contractor shall notify the Chief Engineer for resolution.

#### **No. 16 Cast Iron Streetlight Pole**

Work shall include drilling or slotting the existing base (or newly installed base) in order to install the pole on a new 15" bolt circle foundation. The Contractor shall install the pole plumb. Shimming, if required, shall be done only with manufacturer's supplied shims.

- (B) MEASURE AND PAYMENT.** The unit of measure for Install Streetlight Pole will be per each furnished and/or installed. Payment will be made at the contract unit price per each pole. The payment for installation will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work specified herein.

#### **618.29 REMOVE STREETLIGHT POLES**

- (A) GENERAL.** The Contractor shall furnish all labor, material and equipment to remove streetlight poles and associated equipment, (including conversion kits, lamps, photo cells, wiring within the poles, street signs and poles) as shown in the contract documents. All poles that are to be reinstalled shall be carefully removed. All parts damaged by the Contractor will be replaced by the Contractor at no additional cost to the District. All posts shall be disassembled and inspected by the Contractor for parts that can be reused at

a later time. The Contractor shall supply the District with an inventory of all parts that are removed and re-useable. The Contractor will deliver the re-useable poles or parts to the District's warehouse at 1735 Fenwick Street, N.E., Washington, D.C. All debris, including broken parts, generated as part of this work, will be disposed of by the Contractor at no additional cost to the District.

If the pole is in good condition and is to be reused in the project, the Contractor shall transport the pole to its own storage site.

Backfill and compact all holes created by removing existing metal light poles except holes that will be used again for new light poles. Backfill materials shall consist of suitable soils or granular material.

All streetlight poles and alley light poles are included in this specification.

For combination poles (traffic signal and streetlights), pre-emption and signal cables shall be disconnected and reconnected by District personnel. The Contractor shall remove, tape, rack and test the pre-emption cable as directed by the Chief Engineer. The pre-emption cable shall be reinstalled with traffic signal cable.

- (B) MEASURE AND PAYMENT.** The unit of measure for Remove Streetlight Pole will be each. Payment will be made at the contract unit price per each. The payment will include all labor, tools, materials, equipment, dis-assembly of pole parts, inventory of parts removed and reuseable, delivery of parts, stacking in the warehouse and/or pole yard, disposal of broken parts, debris and all incidentals necessary to complete the work specified herein.

### **618.30 REMOVE STREETLIGHT CONTROL PEDESTAL**

- (A) GENERAL.** The Contractor shall provide for the removal of existing street light control pedestals. The pedestals shall be removed after all series lights (if any) are converted off the circuit and PEPCO has disconnected the pedestals from their system. The pedestal shall be completely removed, the conduits shall be filled with cement, and the excavation shall be backfilled in 6" layers and compacted to match the surroundings. All material removed as part of this work shall become the property of the Contractor and shall be disposed of at no additional cost to the District.
- (B) MEASURE AND PAYMENT.** The unit of measure for Remove Streetlight Control Pedestal will be each. Payment will be made at the contract unit price per each. The payment will include all labor, tools, materials, equipment, excavation, back fill, compaction of the fill all incidentals necessary to complete the work specified herein.

### **618.31 CLEAN AND PAINT STREETLIGHT POLES**

- (A) GENERAL.** The work consists of the cleaning and preparation for painting the streetlight poles, painting of the poles and proper disposal of any hazardous waste.
- (B) COSTRUCTION REQUIREMENTS.** The Contractor shall apply a two-coat paint system as specified herein. The painting of steel and other metal work shall include complete preparation of the metal surfaces, application and protection of the drying paint coatings, removal and proper disposal of existing paint, rust mill scale and hazardous

waste, protection of workers and the environment and furnishing all labor, materials, tools, equipment and incidentals necessary for proper execution of the work.

**(C) CERTIFICATION**

A certified Painting Contractor/Subcontractor shall perform all field painting. All Contractor/Subcontractor personnel working on this item of work shall be qualified and have current certification.

**(D) PROTECTION OF WORKERS AND THE ENVIRONMENT**

Protection of workers and the environment shall be provided by the Contractor as an integral requirement of the performance of the work. The Contractor shall employ the best current methodology for protection of the worker/employee and submit a plan to the Chief Engineer for approval.

**(E) MAINTENANCE AND PROTECTION OF HIGHWAY AND PEDESTRIAN TRAFFIC AND ADJACENT PROPERTY**

The Contractor shall be responsible for any disfigurement by splatters, smirches and splashes of paint on vehicular traffic and pedestrians or adjacent property. The Contractor shall also be responsible for damage to the streetlight pole and adjacent property through the use of equipment.

Proper cloths will be required to minimize splatters of paint on concrete surfaces. Any damage or disfigurement shall be replaced or cleaned at the sole expense of the Contractor.

**(F) CONDITIONS FOR SURFACE PREPARATION AND PAINT APPLICATION**

1. Surface preparation shall not be performed when the surface is below 32 ° F, within 5 ° F of the dew point or when anticipated weather conditions would preclude application of the primer on the same day.
2. Painting shall not be performed when it is likely that moisture in the form of precipitation, fog or dew on contact surfaces that have not cured to water resistance.
3. All surfaces shall be painted with two coats of iron oxide primer.
4. All surfaces shall then be painted with two (2) finish coats of Duron Duraclad 12 Series, or approved equal, the color to match appropriate Federal Color Chip as directed by the Chief Engineer. Each coat is to be applied separately according to manufacturer's recommendations.

**(G) SURFACE PREPARATION**

1. Surfaces shall be prepared for repainting by cleaning with a biodegradable graffiti remover and a de-scaling acid compound.

Biodegradable graffiti remover equal to TAGAWAY, manufactured by Equipment Trade Service Co., Inc.

Descaling acid compound equal to COIL SNAKE, manufactured by Equipment Trade Service Co., Inc.

2. The Chief Engineer will be the sole approving authority of the adequacy of the surface preparation.
3. After the prepared surfaces of existing steel have been inspected and accepted, the surfaces shall be primed the same day. Should rust-back occur before primer application, the affected area shall be cleaned at no extra cost to the District.

**(H) GENERAL REQUIREMENTS FOR FIELD PAINTING**

1. All paint shall be stored, mixed, thinned and applied in accordance with the manufacturer's recommendations. In cases where the manufacturer's recommendations are more lenient than the requirements in this specification, the manufacturer's recommendations shall govern only if specifically authorized by the Chief Engineer.
2. Prior to application of each coat, the surfaces to be painted shall be cleaned as necessary so as to be dry and free of dirt, grease, glue and paper residue and rust. All residue of abrasives, paint and dust remaining after cleaning or other operations shall be removed using a commercial grade vacuum cleaner equipped with a brush type cleaning tool or by double blowing with clean air.
3. All paint shall be mixed using power mixers of a type recommended by the manufacturer. Only complete kits of the iron oxide primer shall be mixed. Iron oxide primer that has exceeded its pot life shall be discarded. Paints shall be frequently mixed during application. Iron oxide primer shall be continuously agitated and shall be applied from containers equipped with a mechanical agitator, which shall be in constant use during application. Paints shall be frequently remixed during application. Paints shall be thinned only with prior approval of the Chief Engineer.
4. Application of paint shall result in a tight film of specified thickness, well bonded to the metal or underlying coatings, including all crevices and corners and shall be free from laps, streaks, sags, bubbles, runs oversprays, dry spray, shadow-through, skips, excessive film build-up, misses and other defects.

**(I) REPAIRS**

1. All defects or damaged areas shall be repaired at the Contractor's expense. Said areas shall be coated with full system as required in these specifications. Repair may be limited to touch-up of damaged areas but in no way shall the number of coats, the required coating system or the dry film thickness of each coat be modified because of the repair procedure.
2. Defects in the paint film, including damage such as scratches and areas of non-adherent paint and rusting shall be repaired.

**(J) PERFORMANCE TESTS AND PRODUCT CERTIFICATION**

The following information shall be submitted as a complete package for approval for each coat in the system selected at least 30 days prior to the anticipated beginning of painting operations:

1. A one (1) quart sample of each coat in the system

2. Certification from the manufacturer that the materials supplied for use as field and repair primer and finish coats contains no more than 0.005% lead.
3. Product and material safety data sheets and application guides the proposed system to the Chief Engineer for material approval.

**(K) PAINTING SCHEDULE AND CONTRACTOR'S SUBMITTALS**

Before any painting operations begin, the Contractor shall submit in writing to the Chief Engineer, as part of the permit application to DCRA, his proposed work schedule, which shall include:

1. A system procedure or plan for all cleaning and painting operations.
2. The type and method of protection against paint splatters, spray, drippings and other disfiguring elements while cleaning and painting over roadways, pedestrian/bicycle paths and areas in the vicinity of private property.

**(L) INSPECTION**

1. Authorized personnel representing the District shall inspect all work. As each operation (cleaning, spot painting and each coat of painting) is completed and prior to any succeeding operation, the Contractor shall notify the Chief Engineer for approval before the next operation may begin. Any work not meeting the approval of the District inspectors shall be rejected and redone until it meets their approval. The method of correction shall be approved by the Chief Engineer prior to proceeding. Should any work be done which proceeds past the point where inspector approval is required, the Contractor shall, at the option of the Chief Engineer, remove said work back to that point at no additional cost.
2. Cleaning and surface preparation of each streetlight shall be entirely completed and accepted before painting commences. All paint shall be suitably dry before any succeeding coat of paint is applied. Any paint applied without prior approval of the Chief Engineer to begin painting shall be removed. This corrective work shall be at the sole expense of the Contractor.

**(M) MEASURE AND PAYMENT.** The unit of measure for Clean and Paint Streetlight Pole will be per each. Payment will be made at the contract unit price per each pole. Payment will include all cleaning and surface preparation, application and protection of paint coatings, repair of damaged or unsatisfactory paint surfaces, preparation and submittal of all required procedures and information, performance of all additional work required by this specification and all labor, materials, tool, equipment, disposal of unsuitable materials and incidentals necessary to complete the work specified.

**618.32 INSTALL ARM ON STREETLIGHT POLE**

**(A) GENERAL** The Contractor shall provide all labor, materials and equipment necessary to furnish and install a metal arm on a streetlight pole owned by the District or any other utility company, as specified in the contract documents. All arms shall be installed as shown on the standard drawings or as specified in the contract documents. Work includes installing the necessary current carrying conductors and any protective moldings, grounding of the arm and installing the tap where the district owns the secondary

conductors feeding the pole. Where the utility company owns the secondary conductors, the Contractor shall leave a 3' pigtail for the utility company's use in making the final connections.

All debris generated as part of this work shall become the property of the Contractor and shall be disposed of at no additional cost to the District.

**(B) MEASURE AND PAYMENT**

The unit of measure for Install Arm on Streetlight Pole will be per each arm complete in place. Payment will be made at the contract unit price per each. The payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work as specified herein.

**618.33 INSTALL BANNER ARM ON STREETLIGHT POLE**

- (A) GENERAL.** The Contractor shall provide banner arms on streetlight poles as specified in the contract documents and as directed by the Chief Engineer. The arms, including mounting hardware, shall be constructed of corrosion-resistant material. The contractor shall submit catalog cuts and samples to the Chief Engineer for approval before any orders are placed. The arms shall be mounted a minimum of 16' from the finished grade to the bottom of the lower arm and such that a 2' x 4' long banner can be installed by others. The contractor shall use care when mounting the banner arms so as not to damage the pole finish. The Contractor shall repair all damage to the pole and pole finish at no additional cost to the District.

All debris generated as part of this work shall become the property of the Contractor and shall be disposed of at no additional cost to the District.

- (B) MEASURE AND PAYMENT.** The unit of measure for Install Banner Arm on Streetlight Pole will be per each. Payment will be made at the contract unit price per each. The payment for installation will include all labor, tools, materials, equipment and all incidentals necessary to complete the work specified herein.

**618.34 INSTALL STREETLIGHT GLOBE**

- (A) GENERAL.** The work consists of providing streetlight globes of the size specified in the contract documents. The globes will be installed on "Washington" type poles. If refractors are specified, the work includes providing refractors and using manufacturer's hardware to complete the item of work.

- (B) MEASURE AND PAYMENT.** The unit of measure for Install Streetlight Globe will be per each. Payment will be made at the contract unit price per each. The payment for installation will include all labor, tools, materials, equipment, disposal of debris and all incidentals necessary to complete the work specified herein

**618.35 INSTALL LUMINAIRES**

- (A) GENERAL.** The Contractor shall furnish all labor, materials and equipment necessary to remove the existing fixture and install a high-pressure sodium (hps) vapor luminaire of

wattage(s) as specified in the contract documents. All high pressure sodium vapor luminaires installed will be of cut-off type (Type III).

Materials shall be as per the contract documents and Section 800.

It is the responsibility of the Contractor to insure that the proper size luminaire is installed. Care must be taken during the installation of the luminaire so that the conductors are not damaged. All conductors damaged by the Contractor will be replaced at no cost to the District. The new luminaire shall be attached securely to the supporting arm or bracket in accordance with the manufacturer's instructions. All luminaires installed must be leveled during the installation, in accordance with the manufacturer's instructions to level the luminaire

In the case of luminaires installed on wood poles, the Contractor may be required to adjust the arm or bracket. If the arm or bracket has an adjustment turn buckle, the Contractor shall use the buckle to bring the luminaire into a level position. If the Contractor cannot adjust the arm so as to level the luminaire, the Contractor shall notify the Chief Engineer.

All conductors that terminate on the luminaire terminal block will be installed to ensure a good connection without damaging the conductors. The conductors should be pushed upward as far as possible away from the heat generated by the ballast. The Contractor will make sure that on luminaires with multi tap ballast, the taps are installed properly according to the manufacturer's instructions.

The photoelectric control shall be oriented so that the word NORTH is directed towards true north. The Contractor shall check to assure that the eye of the control is not facing a foreign light source.

The Contractor shall install a new lamp of the proper type and size. Before leaving the location, the Contractor shall cover the photoelectric control and check that the light is operating properly.

Removal and disposal of the existing fixture are incidental to this work. All debris generated and material removed by the Contractor shall become the property of the Contractor and removed from the site.

- (B) MEASURE AND PAYMENT.** The unit of measure for Install Luminaires will be per each complete luminaire furnished and/or installed. Payment will be made at the contract unit price per each. The payment for installation will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work as specified herein.

#### **618.36 INSTALLCONVERSION KITS**

- (A) GENERAL** The Contractor shall furnish all labor, material and equipment necessary to install high pressure sodium (hps) vapor conversion kit, lamp and night watchman photo cell.

Luminaires installed shall be of wattage as specified in the contract documents. The conversion kit shall be installed inside a #14 or #16 casing and/or other fixture housing, with the proper size and type lamps. Installation shall include the photocell.

During the installation the Contractor meet the following conditions:

1. Kit is held in place by a minimum of three (3) bolts.
2. Conductors are not placed in direct contact with the ballast assembly.
3. Feeder conductors and night watchman photocell lead wires are placed on terminal block or butt end crimped in the appropriate splices and taped.
4. The kit installation does not interfere with the installation and proper tightening of the globe holding devices.
5. The appropriate decal indicating the type and size will be placed on the street side of the casing.
6. The kit shall be mounted so that the lamp center is as close as possible to the center of the globe.

All debris generated and material removed shall become the property of the Contractor and be removed from the site.

- (B) MEASURE AND PAYMENT.** The unit of measure for Install Conversion Kit will be per each conversion kit, lamp and photocell furnished and/or installed. Payment will be made at the contract unit price per each. The payment for installation will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work as specified herein.

#### **618.37 REMOVAL OF LUMINAIRES AND ARMS**

- (A) DESCRIPTION.** The Contractor shall remove all luminaires and arms on wood poles and luminaires on metal poles using bucket truck, after removing conductors from DC or PEPCO manhole. Removal of conductors shall be as follows:

1. Locate power source for underground conductors from a D.C. manhole or a PEPCO manhole for each luminaire.
2. Disconnect power from PEPCO power source before removal of conductors.
3. Remove all underground streetlight conductors from manholes.

- (B) MEASURE AND PAYMENT.** The unit of measure for Removal of Luminaire and Arm will be each. Payment for luminaire removal from wood pole will be made at the contract unit price per each, which payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work specified herein.

No separate measure or payment will be made for the removal of light arm from steel pole, when pole itself is removed. The cost would be incidental to pay item for removal of the steel pole.

#### **618.38 INSTALL SCHEDULE 40 PVC U-GUARD**

- (A) GENERAL.** The Contractor shall furnish all labor, materials and equipment necessary to furnish and install pvc u guard on a wood pole owned by the District or any other utility company as shown in the contract documents or when the Contractor receives a work order from the District. The size to be installed will be stated in the contract or on the work order.

The Contractor shall install a guard any time that he installed a service to underground street and/or alley lights fed from overhead secondary conductors or an underground fed light installed on a wood pole. When required by the contract documents or the work order, the Contractor shall install a u-guard (starting from grade level) on each pole, in order to protect underground to overhead feeder cables. The cost of all mounting hardware shall be included as part of this work. All debris generated as part of this work shall become the property of the Contractor and shall be disposed of at no additional cost to the District.

On wood poles, the contractor shall install the u-guard over the street light feeder cable running up the side of the pole to shield the cables from other utilities (replacing missing or damaged existing u-guard or if a new installation).

- (B) **MEASURE AND PAYMENT.** The unit of measure for Install Schedule 40 PVC U-Guard will be for each linear foot furnished and installed. Payment will be made at the contract unit price per each. The payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete the work as specified herein.

### 618.39 INSTALL GROUND ROD

(A) **DESCRIPTION.**

**New Manholes:**

The Contractor shall provide a ground rod for all new DC owned manholes as indicated in the contract documents. The manholes shall be thoroughly grounded with bare copper wire, size as noted, and braced to the manhole structures and connected to ground rods as shown in the contract documents. Grounding shall be accomplished as soon as materials are in place to which the grounding wires are to be attached.

All ground rods shall be  $\frac{3}{4}$  inch diameter 10-ft long copper clad steel. All the sizes called for in these specifications or as shown in the contract documents are American Wire Gauge sizes. The grounding wire or cables shall conform to the requirements of ASTM B8. Ground wires shall be soft drawn.

**Existing Wood Poles:**

The Contractor shall inspect existing streetlight wood poles identified in the contract documents, in work orders or as directed by the Chief Engineer, for the existence of an electrically sound ground system for the streetlight mast arm. If no ground path is found, the Contractor shall notify the Chief Engineer who may issue an approval or work order for the installation of a grounding system.

If the approval/work order is issued, the Contractor shall install a  $\frac{3}{4}$ " ground rod at the base of the pole in such a way as to have a minimum soil contact of eight (8) foot. A ground wire shall be provided and connected to the rod by thermite welding. The ground wire shall be attached to the street light arm with approved clamp. A one inch (1") U-Guard shall be installed to protect the ground wire from grade level to a minimum of 8 ft. up the pole.

**Existing Manholes**

DC Manholes or manholes identified in the contract documents will be checked to verify the existence of a ground rod. If no ground rod is found, a  $\frac{3}{4}$  " ground rod shall be installed

through the floor of the manhole in such a way as to have a minimum soil contact of 8 feet. The Contractor shall make the electrical connections in the existing D.C. manholes between the ground rod, neutral conductor and any ground wires using exothermic welds and cover the welds and exposed cables with two coats of insulating varnish.

- (B) **MEASURE AND PAYMENT.** The unit of measure for Install Ground Rod will be each. Payment for a new ground rod will be made at the contract unit price per each. The payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

**618.40 PAYMENT TO TRAFFIC SIGNAL CONTRACTOR FOR CONNECTION AND DISCONNECTION OF TRAFFIC SIGNAL CABLES**

- (A) **GENERAL.** The Contractor shall make payments to the District-designated contractor for Traffic Signal cable connections and disconnections for combination streetlight/traffic signal poles. DC forces or District-designated traffic signal contractor will perform all traffic signal cable disconnection and connection. Up to four (4) visits by the traffic signal contractor may be needed per combination pole.

The Contractor shall include in his bid the amount shown in the Pay Item Schedule to pay the traffic signal contractor for work performed as required in the contract. The traffic signal contractor will submit all invoices to the Contractor for payment. After payment has been made, the Contractor shall submit the paid invoices to the Chief Engineer for reimbursement by the District. The District will pay the Contractor only the invoice amount.

- (B) **MEASURE AND PAYMENT.** The unit of measure will be per hour of Traffic Signal Contractor crew. Payment will be made to the Contractor based on paid Traffic Signal Contractor's invoices. Contractor mark-up shall not be allowed.

**618.41 PAYMENT TO PEPCO FOR CONNECTION, DISCONNECTION AND INSPECTION OF SERVICE TO STREETLIGHTS**

- (A) **GENERAL.** The Contractor shall make payments to the Potomac Electric Power Company (PEPCO) for service connections, disconnections and PEPCO manholes entry fees. Up to two (2) visits by pepco forces may be needed. The PEPCO manhole entry fee package will be enclosed with the contract documents.

The Contractor must schedule his work around two (2) PEPCO manhole entries per manhole; any additional service visits will be the responsibility of the Contractor at no additional cost to the District. The Contractor shall include in his bid the amount shown in the Pay Item Schedule to pay PEPCO for work performed as required in the contract. PEPCO will submit all invoices to the Contractor for payment. After payment has been made, the Contractor shall submit the paid invoices to the Chief Engineer for reimbursement by the District. The District will pay the Contractor only the invoice amount.

- (B) **MEASURE AND PAYMENT.** The unit of measure will be per hour of PEPCO crew. Payment will be made to the Contractor based on the paid pepco invoices. Contractor markup shall not be allowed.

## **619 MECHANICAL WORK**

### **619.01 DESCRIPTION**

Mechanical work shall consist, where applicable, of furnishing, installing, testing, and placing in satisfactory operation all ventilation equipment, pumping equipment, and other equipment as specified herein and in the contract documents to make a complete mechanical system.

### **619.02 CODES AND STANDARDS**

The materials, equipment, tests, and installations shall conform to the latest published applicable codes and standards of the organizations mentioned below:

District of Columbia Sanitary Codes

American Society of Mechanical Engineers

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., ASHRAE Guides and Data Books

Air Moving and Conditioning Association

Society of Automotive Engineers

National Electrical Manufacturers Association

American Society for Testing Materials

Institute for Electrical and Electronics Engineers

National Fire Protection Association

American National Standards Institute

Underwriter's Laboratories, Inc.

Hydraulic Institute Test Code

### **619.03 MATERIALS**

Materials for mechanical work shall be as specified in the contract documents.

### **619.04 SHOP AND WORKING DRAWINGS**

All shop and working drawings relating to mechanical work shall be submitted as specified in 105.02.

### **619.05 VENTILATION SYSTEM**

The ventilation system shall consist of air supply fans, forced exhaust fans, exhaust fans, motors, transmissions, duct work, and other equipment as specified herein and in the contract documents in strict compliance with all codes and standards cited in 619.02.

All fans and parts thereof shall be capable of satisfactorily withstanding the effect of all stresses and loads under the starting and operating conditions specified for fan motors.

In cases where fans are intended for vehicular tunnel service, the Contractor shall furnish certification that the proposed fans, motors, dampers, sound attenuators and other ventilation system accessories that can be exposed to elevated airflow temperatures are in compliance with the high temperature requirements contained in the current edition of NFPA 502. In addition, the Contractor shall submit certification that the proposed fans and accessories comply with all relevant requirements contained in the current edition of NFPA 502.

In cases where the proposed fan provides emergency tunnel ventilation or serves critical areas such as electrical, control and communications spaces, the Contractor shall furnish the Chief Engineer with certified copies of the performance curves for the fans he proposes to furnish and install prior to approval of fans by the Chief Engineer. Performance curves shall be plotted for the operation of the fan with abscissa as cubic feet per minute and ordinates as:

1. Total pressure in inches of water
2. Static pressure in inches
3. Total efficiency in percentage
4. Static efficiency in percentage
5. Horsepower input to the fan
6. Horsepower output of driving motor

Typical curves for fans are not acceptable for any fan that provides emergency ventilation or serves a critical area as described above. In cases where reversible fans are specified, the Contractor shall provide performance curves for both directions of fan operation.

Typical fan curves are acceptable for fans that do not serve critical areas..

In addition to fan curve, each fan shall have a brass or stainless steel nameplate showing the name of the manufacturer, type of fan, fan number, shop order number, serial number, cubic feet of air per minute, and static pressure at rated maximum operating speed. Name-plate shall be fastened on the fan with self-tapping screws.

#### **619.06 PUMPING SYSTEM**

The Contractor shall furnish, install, test, and place in satisfactory operation all pumping equipment and accessories as specified in the contract documents or as required for a complete installation in strict compliance with all codes and standards referred to in 619.02.

The Contractor shall furnish certified characteristic curves of the pump along with other data to the Chief Engineer for his approval of the pumps. The performance curves shall show the total head, horsepower, efficiency, and volume of water delivered for the full range from the point of no delivery to that of free delivery.

#### **619.07 MOTORS**

The Contractor shall furnish and install the type and size of motors and associated equipment as specified in the contract documents.

The Contractor shall furnish certified performance curves before the motors are approved. Performance curves shall include the speed, starter current, power factor, efficiency, horsepower output, and kilowatt input, all plotted against torque from 50 percent to 125 percent of full load at rated voltage.

Each motor shall have a brass or stainless steel nameplate showing the name of the manufacturer, type of motor according to NEMA design, full load current, voltage, speed, temperature rise (by resistance), and service factor. Nameplate shall be fastened on the motor with self-tapping screws.

The motor conduit box and bearings shall be one size larger than the standard size.

Each motor shall be given the standard NEMA commercial test and the Chief Engineer shall be furnished, for approval, a notarized copy of such tests, before the motors leave the place of manufacture.

The Contractor shall submit certification that motors serving emergency ventilation fans can withstand elevated temperatures as defined in the current edition of NFPA 502.

#### **619.08 MEASURE AND PAYMENT**

The unit of measure for Mechanical Work will be job. Payment will be made at the contract lump sum price, which payment will include the cost of all equipment, manufacturer's guarantees, tests, and all labor, materials, tools and incidentals necessary to complete the work.

## 620 TRAFFIC SIGNING

### 620.01 WOOD SIGN POSTS

(A) **DESCRIPTION.** Work consists of furnishing, fabricating, and erecting all break-away type wood signposts, of the dimensions specified in the contract documents. Work also includes furnishing foundation sleeves for ground-mounted signs specified in the contract documents.

(B) **MATERIALS.**

Wood Posts – 822.12(C)

Preservative – 811.08(C)

Post Sleeves shall be 12 gauge steel, galvanized in accordance with AASHTO M 111

Primer Sealer – 811.03(D)

Paint shall meet requirements of FS TT-P-71 and shall be tinted to match color green, No. 14109 of Federal Standard 595

(C) **CONSTRUCTION REQUIREMENTS.** Sleeves shall be set as part of PCC footing work. Posts shall be cut to length and drilled or cut for the breakaway requirements as necessary and specified in the contract documents and as specified in AASHTO Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals prior to the preservative treatment.

Samples of posts with their preservative coating shall be submitted before erection for the written approval of the Chief Engineer.

Painting – Post shall be given one complete coat of primer sealer and one uniform coat of green paint. Erection shall not begin until paint is dry to heavy thumb pressure. Painting of posts will not be required on posts used in work zones as temporary sign supports.

Erection – Permanent Wood Sign Posts shall be set plumb in the sleeves at the depth and lateral position as specified in the contract documents. The space between rim of sleeves and projection of posts shall be carefully cleaned and filled with joint sealant meeting requirements of FS TT-S-227, Class B. Sealant shall be tool finished smooth. Backing material for sealant shall be installed as directed.

(D) **MEASURE AND PAYMENT.** The unit of measure for Wood Sign Posts will be per linear foot. Payment will be made at the contract unit price per linear foot, complete in place, which payment will include furnishing galvanized steel sleeves, sealant, cutting post tops and incidentals necessary to complete the work. Wood Post foundations will be paid under 602.

### 620.02 METAL SIGN POSTS

(A) **DESCRIPTION.** Work consists of furnishing and erecting new flanged steel channel sign posts at locations as specified in the contract documents or as directed by the Chief Engineer.

**(B) MATERIAL.**

Flanged Steel Channel Posts – 824.03, ASTM A 499 Grade 60

- (C) CONSTRUCTION REQUIREMENTS.** The posts to support the specified sign shall be driven to the depth shown in the standard drawings. The posts shall be driven using drive caps designed for the size of posts used. The posts shall be plumbed and if more than one post is required per sign, the Contractor shall ensure that the distance between posts is correct to accept the pre-drilled sign.

The weight of the post shall be as specified and shall be 2.00, 3.00 or 4.00 pounds per foot. The posts shall be painted with baked green enamel. All punching, boring, cutting or shearing shall be performed prior to painting. The posts shall be punched with continuous 3/8 inch diameter holes on one inch centers for the entire length of the post with the first hole one inch from the top.

- (D) MEASURE AND PAYMENT.** The unit of measure for Metal Sign Posts will be per linear foot. Payment will be made at the contract unit price per linear foot, complete in place, which payment will include furnishing all labor, equipment, cutting post and incidentals necessary to complete the work.

**620.03 GUIDE SIGN PANELS AND TRAFFIC SIGN PANELS**

- (A) DESCRIPTION.** Work consists of furnishing, fabricating and erecting Guide Sign Panels and Traffic Sign Panels, of sheet aluminum or of extruded aluminum, including all letters, numerals, symbols and characters, borders, reflective sheeting, and mounting hardware. All features of the sign shall meet the requirements of the MUTCD. The locations and sign messages and/or symbols will be as indicated in the contract documents. Sign supports shall be as specified in the contract documents.

**(B) MATERIALS.**

Reflective Sheeting – 824.02, AASHTO M 268

Sheets, Plates, Angles, Z-bars, Lock Tabs, Support Angles and Panel Hardware – 824.04

Sheet Aluminum – 824.04, ASTM B 209

Extruded Aluminum – 824.04, ASTM B 221

Demountable Characters and Borders, Non-demountable Characters, 824.04

The Contractor shall submit manufacturer's certification in accordance with AASHTO M 290.

- (C) CONSTRUCTION REQUIREMENTS.** The size of letters and messages shall be as specified in the contract documents. Guide sign borders shall be of the width and color specified.

Guide Sign Panels exceeding four (4) square feet in area shall be fabricated of extruded aluminum sheets. Guide Sign Panels less than four (4) square feet in area shall be fabricated of flat aluminum sheets. Guide Sign Panels shall meet the requirements of the

MUTCD. The reflective sheeting for Guide Sign Panels shall be Type III high intensity sheeting.

Traffic Sign Panels, including regulatory and warning signs meeting the requirements of the MUTCD for color and size, shall be fabricated of flat aluminum sheets. The reflective sheeting for Traffic Sign Panels shall be Type III or Type IX as specified in the contract documents.

The reflective sheeting shall be free of ragged edges, cracks, and extraneous material and applied to prepared aluminum backing. The aluminum backing shall be properly prepared by degreasing and etching or treated according to the recommendations of the sheeting manufacturer. Sign faces comprising two or more pieces or panels of reflective sheeting shall be carefully matched for color to provide a uniform appearance during daylight and darkness. Alternate successive width sections of sheeting shall be reversed and consecutive to insure that corresponding edges of sheeting lie adjacent on finished sign. Non-uniform shading and undesirable contact between adjacent widths of applied sheeting will not be permitted.

Patched sheeting shall not be permitted.

The reflective sheeting for extruded aluminum sign panels shall be the pressure sensitive type. Splicing of the sheeting will not be allowed except splices permitted by the sheeting manufacturer. The sheeting shall be rolled over the edge of the extrusion  $\frac{1}{4}$  inch. Letters, numerals, symbols, borders and route numbers for extruded aluminum sign panels shall be demountable copy of the specified reflective sheeting applied to properly prepared flat sheet of 0.032 inch minimum thickness aluminum sheet of 6061-T6 alloy. Mounting shall be accomplished with aluminum blind rivets with the head painted the color of the copy and the surface shall present a smooth surface.

The reflective sheeting for sheet aluminum sign panels shall be pressure sensitive or heat activated type. Splicing of the sheeting will not be allowed except splices permitted by the sheeting manufacturer. Splices will not be permitted on signs which are screen processed with transparent color.

Guide Sign Panels shall be fabricated from an aluminum extrusion to 0.125 inch thickness at the surface and to .078 inch at the walls, as per Standard Drawing 620.07.

Traffic Sign Panels shall be cut from a single aluminum sheet of 0.063 inch thickness or as shown on the contract plans and fabricated to the size and shape shown on the contract plans. Sheets may be sheared, blanked, sawed, or milled; no flame cutting will be permitted. Cut edges shall be true, smooth, and free from burrs or ragged breaks and panels shall show no deviation from flatness when examined from a distance of 20 feet. Mounting holes shall be punched or drilled.

Sign Panels shall be provided with the necessary mounting hardware including angles on the back face at the joints to hold the abutting panels firmly and in proper alignment. All sign panel fastenings, lock tabs, and aligning angles shall be applied in such a manner as to cause a minimum of projection of the sign face. Where lock tabs are not used, end panel sections shall be provided with hook-bolted connections to horizontal stringers to keep all panel sections tightly joined, and centered horizontally on the stringers. These hook-bolt connections shall not be visible from the sign face.

Backs of sign panel sections shall be provided with suitable fasteners to permit easy attachment to the supporting zee stringers. Stringers shall be fastened to the panels with aluminum or stainless steel bolts, nuts, and washers, or with extruded aluminum lock tabs. Lock tabs shall be fastened to the sign panels by spot welding or by counter-sunk head aluminum bolts. Aluminum bolts shall be used in strict accordance with the manufacturer's recommendations, subject to the approval of the Chief Engineer. Two copies of the manufacturer's specifications and instructions for the bolts and type of aluminum used shall be delivered to the Chief Engineer prior to use. Tubular stiffeners shall be provided with end flanges with the bolt holes where indicated on plans. Stiffeners shall be fastened to the zee stringers with bolts through the neutral axis of the zee section web.

Where aluminum comes in contact with steel other than stainless steel, a 1/16 inch thickness approved insulating material as specified herein shall be placed between the two members. This material shall be used in all cases whether indicated on the plans or not.

Field drilling of holes will not be permitted in any part of the structural assembly unless approved by the Chief Engineer.

All welding of aluminum alloys, except spot welding, shall be performed by the inner-gas-shielded, tungsten or consumable-electrode method. Both the welding procedure and the welders shall be qualified in accordance with the requirements of ASME BOILER AND PRESSURE VESSEL CODE, SECTION IX. Three certified copies of the qualification test (Form Q-1, Form Q-1G and/or Form Q-1F whichever is applicable) as required by the above code, shall be properly completed and furnished the Chief Engineer. All welds shall be neatly formed, and shall be free from cracks, blow-holes, and other irregularities.

No field welding will be permitted on any part of the sign panel.

Legends for sheet aluminum signs shall be applied by the direct or reverse screening process. Legends shall be uniform in color, free from ragged edges, runs, drops and other faults affecting sign appearance. Copy registration shall be accurate. The finished screened area shall exhibit uniform film thickness, hiding power and proper color and shall be satisfactory to the Chief Engineer.

Alternate details may be submitted to the Chief Engineer for approval, for structural framing and brackets needed to mount sign panels to supports.

The Contractor shall furnish, for approval of the Chief Engineer, complete shop drawings for guide signs showing panel assembly, stringer size and spacing, letter size, letter and word spacing, bracket and support spacing, type and color of message components, and sign face arrangement.

All panel fabrication, including cutting and punching or drilling of holes, shall be complete prior to metal degreasing and application of reflective sheeting. Metal panels shall be cut to size and shape and shall be free of buckles, warp, dents, cockles, burrs, and defects resulting from fabrication. The front surfaces of all sign panels shall be flat.

All guide, regulatory, warning, or other traffic sign panels damaged as a result of the Contractor's operations shall be restored to their original condition or be replaced by the Contractor at his own expense, to the satisfaction of the Chief Engineer.

Prior to final acceptance of the work, the signs will be inspected. If specular reflection is apparent on any sign, the sign panel shall be adjusted by the Contractor at his sole expense to eliminate this condition.

- (D) **MEASURE AND PAYMENT.** The unit of measure will be the square foot of sign panel or traffic sign mounted in place. Payment for Guide Sign Panels and Traffic Sign Panels will be made at the contract unit price per square foot which payment will include furnishing, fabrication, erection, mounting brackets and hardware, final sign adjustments and all labor, tools, materials, equipment, and incidentals necessary to complete the work.

#### **620.04 FEDERAL AID PROJECT SIGN**

- (A) **GENERAL** The Contractor shall furnish, erect, maintain and remove as directed by the Chief Engineer one Federal-Aid Project Sign at each end of the project under construction as shown on the detailed drawing included in the contract documents. Cost figures for insertion on signs, rounded to the nearest \$1,000.00, will be provided by the Chief Engineer. The Chief Engineer will provide the project description and the U.S. Route number if any.

The sign shall be 3' X 5' X 3/4" exterior plywood, substrate smooth sanded on one side. The sign will be mounted on three 4" x 4" x 12' posts (or approved alternate) at location(s) designated by the Chief Engineer. The sign face shall be painted with three (3) coats of outdoor white enamel; sign rear with one (1) coat of same enamel. Lettering shall be of silk screen enamels; black for all lettering; crimson red for the D.C. Logo. The sign shall include the Rebuilding DC logo as shown in the contract documents.

#### **(B) COLORS**

Red – Pantone 485    Blue – Pantone 280    Light Blue – Pantone 305

Gray – CiCy 2, and Black over White

#### **(C) FONTS**

Ariel Narrow Italic or Ariel Narrow Bold Italic may be used. Sizes: 180 pt., 140 pt., 120 pt. and 100 pt.

- (D) **ARTWORK.** Rebuilding DC Logo will be provided with the fonts outlined, EPS-JPEG Adobe Illustrator file on Mac formatted 3.5 disk or as required by the Chief Engineer.
- (E) **OUTPUT.** Digitally reproduced sign. Printed or silk screened.
- (F) **MEASURE AND PAYMENT.** The unit of measure for Federal Aid Project Sign will be per each sign furnished for the contract. Payment for Federal Project Sign will be made at the contract unit price per each, which payment will include labor, materials, equipment and incidentals necessary to furnish, erect, maintain and remove the sign.

**620.05 DELINEATORS, REFERENCE POSTS AND OBJECT MARKERS**

- (A) **DESCRIPTION.** Work consists of furnishing and installing Delineators, Reference posts and Type I, II, III and End of Road Object Markers as shown in the contract documents or as directed by the Chief Engineer. The Delineators, Reference posts and Object Markers shall be installed in accordance with the requirements of the MUTCU.
- (B) **CONSTRUCTION REQUIREMENTS.** The Delineators, Reference Posts and Object markers will be installed on flanged channel posts. The posts shall be driven to the correct height and plumbed prior to installing the Delineators, Reference Posts and Object Markers.
- (C) **MATERIALS.** Reflective Sheeting Type III. 824.02 Flanged Steel Channel Posts 1.33 LB/LF, 824.03, ASTM A 499 Grade 60
- (D) **MEASURE AND PAYMENT.** The unit of measurement for Delineators, Reference Posts and Object Markers will be each. Payment will be made for each Delineator, Reference Posts and Object Marker complete in place and which payment includes the flanged steel channel post support and all labor, equipment and incidentals to complete the work specified herein.

**620.06 BREAKAWAY BASE SIGN SUPPORT SYSTEMS**

- (A) **DESCRIPTION.** The work consists of furnishing and installing Breakaway Base Sign Support Systems as specified in the contract documents. Breakaway Base Sign Support system is shown in the Standard Drawings 620.04 and 620.06. The Contractor may submit an alternative system which meets or exceeds NCHRP Report 350, Test Level 3.
- (B) **CONSTRUCTION REQUIREMENTS.** The Contractor shall furnish and install Breakaway Base Sign Support Systems including post hinge assembly units as specified in the Contract Documents and in conformance with the manufacturer's recommendations. The Contractor shall grade the ground around the foundation as part of this work. The Contractor shall provide the type of foundation for the Breakaway Base Sign Support System specified and shall ensure that the foundation is trued and at the proper dimensions to accept the support system and specified sign.
- (C) **MATERIALS.** Breakaway Base Sign Support Systems shall conform to the breakaway requirements specified in AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and approved by the Chief Engineer.

**STEEL AND HARDWARE 824.03, AASHTO M 1164**

Concrete 817.03, (A) Type F.

- (D) **MEASURE AND PAYMENT.** The unit of measure for Breakaway Base Sign Support System will be for each. Payment will be at the contract unit cost for each Breakaway Base Sign Support System. A Breakaway Base Sign Support System will consist of a post, hinge assembly, base plates and necessary hardware and a foundation for the complete system in place. Payment also includes all labor, equipment, excavation, backfill, grading adjacent to the foundation and incidentals to complete the work specified herein.

**620.07 MODIFY AND REPAIR EXISTING SIGN**

- (A) **DESCRIPTION.** The work consists of modifying existing sign messages and repairing existing signs. Ground mounted and over head signs are included. Sign patching and the replacement of demountable copy will be necessary as a part of this work.
- (B) **CONSTRUCTION REQUIREMENTS.** Damage to reflective sheeting may be repaired and the edges sealed according to the requirements of the manufacturer's recommendations. The sign patch material shall be the same type and color as the surrounding sheeting. Patching will not be permitted on any letter, numeral, arrow symbol or border. Overlayment and demountable copy including borders that are existing shall be removed to facilitate the installation of the new overlayment. Deformations in the sign panel shall be smoothed and corners straightened.

Overlayments of 3 feet or less in length shall be accomplished with one panel. Overlayments greater than 3 feet in length shall be accomplished with panels no less than 3 feet wide. All joints shall be tightly butted and not overlapped.

Overlays shall be attached to the signs with aluminum rivets of a length to securely fasten the overlay to the sign panel. The rivets shall be installed in a pattern that will prevent the buckling of the panels.

**(C) MATERIAL**

Reflective Sheeting: 824.02, Type III or IX

Aluminum: 824.04

- (D) **MEASURE AND PAYMENT.** The unit of measure for Modify and Repair Existing Sign will be the square foot. Payment will be at the contract unit cost for the square foot of sign overlaid, which payment will include furnishing, installing overlays for existing signs and all labor, equipment and incidentals to complete the work specified herein.

**620.08 REMOVE AND RELOCATE EXISTING SIGNS AND SUPPORTS**

- (A) **DESCRIPTION.** The work consists of removing and relocating existing signs and sign supports as specified in the contract documents. Ground mounted and overhead signs, and ground mounted sign supports are included.
- (B) **CONSTRUCTION REQUIREMENTS.** Existing signs and sign supports will be removed are relocated for traffic pattern changes or during construction work. If the existing signs and sign supports are to be replaced with new signs of similar messages or a part of a sequence of signs, new signs shall be installed prior to the relocation or removal of the existing signs and supports. When the existing sign is to be replaced using the existing supports, the existing sign shall not be removed until a new sign is ready and on site for immediate installation. The existing sign support shall be totally removed and holes and foundation cavities backfilled. The holes for flanged steel channel posts and wood posts shall be backfilled with suitable material as specified in 804. The posts shall be extracted with a minimum disturbance to the area surrounding the existing sign. The wood sign posts foundation and sleeve shall be extracted with the wood post. Foundations for breakaway base sign support systems shall be demolished to a depth of one foot below grade.

Existing overhead signs shall be removed and relocated and the existing sign luminaires shall also be removed. All cable feeding the luminaires shall be removed and terminated in a manner so as to maintain service to the remaining overhead sign luminaires.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Remove and Relocate Existing Signs and Supports will be the square foot. Payment will be made at the contract unit price per square foot of sign removed or relocated. Payment for relocated ground mounted breakaway sign supports for relocated signs will be paid according to 620.06. Payment will include all labor, equipment, necessary backfill, tools and incidentals necessary to complete the work specified herein.

## 621 MISCELLANEOUS ELECTRICAL WORK

### 621.01 DESCRIPTION

Miscellaneous Electrical Work shall consist of furnishing all labor, equipment and materials and installing all electrical equipment, conduits, manholes, pull boxes, wiring, transformers, fixtures, non-roadway lighting, and all electrical facilities as shown in the contract documents, and as specified herein for a complete working electrical system. This work shall also include necessary excavation, and backfill, disposal of discarded materials and restoration of disturbed facilities and surfaces in accordance with these specifications.

Wherever the word “provide” is used, it shall mean “furnish and install complete in place and ready for use.”

Items of electrical equipment shall consist of products of the same manufacturer, as far as practicable. Each system shall conform as to voltage, amperage, frequency, and type specified.

In order to provide the proposed lighting system the Contractor shall cooperate with PEPCO. PEPCO will supply the type of power required at the locations outlined in the contract documents.

### 621.02 CODES AND STANDARDS

Material, equipment and installation shall conform to the following:

American Society for Testing and Materials (ASTM)

American National Standards Institute (ANSI)

Certified Ballast Manufacturers

Institute of Electrical and Electronic Engineers (IEEE)

Insulated Power Cable Engineers Association (IPCEA)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

Underwriters Laboratories, Inc. (UL)

District of Columbia Electrical Code

National Electric Safety Code

United States of America Standards Institute (USASI)

Rules and Regulations of the Potomac Electric Power Company (PEPCO)

American Association of State Highway and Transportation Officials (AASHTO)

Electrical contractors must be bonded in the District and their electricians must have District licenses. The Contractor’s Master Electrician shall secure a permit approved by the Electrical Engineer, D.C. prior to starting any project work, and the Master Electrician shall be

responsible for all project electrical work. The project electrical work shall at all times be inspected by electrical inspectors of the Department of Transportation.

No work shall be covered at any time prior to inspection.

The Contractor must have approved shop drawings, catalog cuts, and specifications available at the jobsite for inspection by the Chief Engineer and the Department's electrical inspector.

### 621.03 MATERIALS

- (A) **GENERAL.** New first quality materials shall be furnished in conformance with 819. Material and equipment must be UL listed and labeled. All electrical parts, switches, wire, and other elements of the installations shall be of ample capacity to carry required current without excessive heating or causing an excessive drop in potential. Except as otherwise provided herein, each individual item of equipment shall bear a nameplate or other type of indelible marking or brand that shall identify it as to type, catalog number, and manufacturer, and shall be heavy duty industrial-rated. This applies to hardware and miscellaneous materials.
- (B) **COORDINATION WITH OTHER TRADES.** It shall be the responsibility of the Contractor to coordinate the location of equipment, conduit, devices, fixtures, outlets, etc., furnished and installed under other sections and by other trades to the extent that interference among such items is avoided. Relocation of items required as a result of failure of the Contractor to coordinate his work with the work of other trades shall be at the expense of the Contractor and at no additional cost to the District.
- (C) **STANDARD PRODUCTS.** Unless otherwise indicated, materials furnished shall be standard products of a manufacturer regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design complying with the specification requirements.

Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type, or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid. Specified materials shall be furnished unless changed by mutual agreement. Where two or more designations are listed, the choice shall be optional with the Contractor.

Should the Contractor propose to furnish materials and equipment other than those specified, as permitted by the "or approved equivalent" clauses, he shall submit a written request for any or all substitutions to the Chief Engineer and must demonstrate that the equivalent product being submitted is equal to or exceeds all technical performance and visual criteria of the original specified item. Where such substitutions alter the design or space requirements indicated on the plans, the Contractor shall include in his request all items of cost for the revised design and construction including cost of all allied trades involved.

Acceptance of the proposed substitutions shall be subject to approval of the Chief Engineer. If requested by the Chief Engineer, the Contractor shall submit for inspection samples of both the specified and the proposed substitute items.

In all cases where substitutions are permitted, the Contractor shall bear any extra cost of evaluating the quality of the materials and equipment to be installed.

- (D) **SAMPLES.** When samples are required they shall be submitted to the Chief Engineer for approval within 8 weeks after award of contract or prior to start of work, properly marked for identification and free of expense to the District. The District reserves the right to mutilate or destroy any sample submitted when considered necessary for testing purposes. Samples not so mutilated or destroyed will be returned to the Contractor at his expense when no longer necessary for the performance of the contract. Sections 106.01, 106.02, and 106.03 shall apply to samples and materials used in conjunction with Electrical Work.

The Contractor shall submit the following:

- (1) The name and manufacturer of the equipment he proposes to furnish.
  - (2) Such data and descriptive materials as may be necessary for the mechanical trades in connection with maintenance.
  - (3) All wiring or necessary diagrams and drawings for approval.
  - (4) Any additional samples if deemed necessary.
- (E) **MATERIAL AND WORKMANSHIP.** Installation work shall be in accordance with the contract documents. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired by the Contractor in a manner meeting the approval of the District without additional compensation.

The contract drawings indicate the extent and general arrangement of the conduit and wiring systems. If departures from the contract drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted as soon as possible to the District for approval. No departures shall be made without prior written approval.

The Contractor shall be responsible for all cutting and patching necessary for accomplishing the work. All such modified areas shall be left in as good repair as prior to the beginning of this work, at the expense of the Contractor and at no additional cost to the District. Cutting of structural members shall not be done without approval of the Chief Engineer.

Materials and items of work shall be as specified in 819, on the contract plans and/or in the Special Provisions.

- (F) **GUARANTY.** The Contractor shall guarantee all electrical work to be in accordance with contract requirements and free from defective or inferior materials, equipment, and workmanship for a period of 1 year from date of acceptance of the electrical work.

If, within the guaranty period, the Department finds that guaranteed work needs to be repaired or changed because of the use of materials, equipment, or workmanship which are inferior, defective or not in accordance with the terms of the contract, the Department shall so inform the Contractor in writing and the Contractor shall promptly and without additional expense to the District: (1) Place in a satisfactory condition all such guaranteed work; (2) Make good all damage to equipment, the site, the structure, and/or related

appurtenances, which is the result of such unsatisfactory guaranteed work; (3) Make good any work, materials, and equipment that are disturbed in fulfilling the guarantee.

Should the Contractor fail to proceed promptly in accordance with the guarantee, the District may cause such work to be done and the Contractor and the surety or sureties under the bond shall be jointly and severally liable for the cost of same.

#### **621.04 CONTRACT PLANS AND MANUFACTURER'S DRAWINGS**

- (A) **ELECTRICAL PLANS.** These plans indicate the general arrangements of circuits and conduits and the locations of outlets, equipment, other devices, and appurtenances. The plans and Special Provisions are intended to show and describe the work entirely. However, every item necessary to complete the work may not be specifically shown or mentioned. Equipment necessary for the proper operation of a complete electrical system, such as power connections, wiring, and minor items such as fittings, transitions, hangers, etc., not shown or specified, shall be included in the work. The Contractor shall be responsible for furnishing all materials for the installation, complete, so as to insure the successful operation of the equipment.
- (B) **MANUFACTURER'S DRAWINGS.** Manufacturer's drawings shall consist of all shop and installation drawings, catalogs, photometric curves, performance data, equipment installation details, etc. The Contractor shall secure and/or prepare these drawings and submit them as required by 105.02 before purchasing materials or proceeding with construction. Shop drawings shall show complete details of construction for all portions of the work included. Drawings shall be clearly marked to show building location, equipment item or device number, and any other information required to clearly associate an item with its intended application. All electrical diagrams and symbols used on shop and working drawings shall conform to NEMA and/or USASI Standards. The Contractor shall check each drawing to insure conformance with the contract plans and specifications, and each shall bear the Contractor's signature and certification. Drawings and data not clearly identified will be returned without approval to the Contractor.

Transmittals accompanying all shop drawings shall contain names and addresses of the Contractor, subcontractors, and suppliers. Project title, reference to prior actions on submissions and specification reference shall also be indicated.

#### **621.05 STRUCTURE GROUNDS**

Each bridge, wall, overhead section of guide sign structure, all non-current carrying metal parts for roadway lighting systems, and other structures having electrical elements contained therein or attached thereto shall be permanently grounded and checked for a grounding condition.

Furnishing of all materials necessary to provide the entire structure grounding system, including ground rods complete in place, shall be included in this item. Grounding shall be accomplished as soon as materials are in place to which the grounding wires are to be attached.

Each lighting standard shall be grounded with a No. 8 stranded copper wire connecting the pole shaft to the adjacent junction box. Each conduit pipe cap inside a lighting standard shall

be replaced with an insulated grounding bushing fitting. This bushing shall be bronze, threaded and shall be provided with an insulator ring mechanical bonding wire connection.

Connections of all grounding cables shall be made with approved solderless mechanical connectors made of copper alloy with silicon bronze components.

In order to provide continuity in the grounding of conduit at light poles on bridge structures, No. 8 AWG, stranded, bare, soft drawn copper wire shall be installed between grounding lugs of each grounding bushing and the ground lug or bolt in the pole base. Where the plans require the use of a raceway employing a junction box with locknuts and bushing connections, the work shall be connected between the grounding bushings and the pole ground connection.

In order to minimize potential differences between units of a bridge structure, each unit shall be electrically tied to each adjacent unit both longitudinally and transversely with grounding cable connecting the outside girders or beams together or as shown on the plans. The superstructure shall be grounded with wire brazed to the structure and connecting to the rods as shown on the plans. The ground and bonding jumper copper wire, suitably looped, shall be installed to allow for movement of the girders. Transverse electrical ties need not be made when the lateral separation between sections of parallel bridges is 6 feet or greater. Two coats of insulating varnish shall be applied over all exothermic welds and exposed cable.

#### **621.06 GROUND RODS**

Ground rods conforming to 820.10 shall be driven at the location shown on the plans. Copper wire conforming to 820.11 shall be secured to the upper end of the ground rod with an approved connection. If required by the plans, the ground conductor shall be installed in a 3/4 inch rigid conduit between the ground rod and service and control equipment enclosure as shown on the plans. The ground conductor connection to the ground rod shall be accessible for inspection after completion of installation.

Each ground rod shall be tested as specified in 621.16 (A). If the earth resistance measurement exceeds 25 ohms, a second ground rod shall be installed as shown on the plans. The two rods shall be temporarily connected together with ground wire and the earth resistance measured. If the earth resistance still exceeds the above value, a 10-foot rod shall be exothermically welded to the top of the second rod to constitute a continuous 25-foot long rod. After this is driven into the earth it shall be temporarily connected to the first rod and the earth resistance measured. If the earth resistance still exceeds the required value, this procedure of lengthening and driving the second rod shall continue until either an acceptable value of earth resistance is obtained or the extended rod cannot be driven further.

If the measured earth resistance still exceeds the required value after the last rod is driven and interconnected, the Chief Engineer shall be contacted for his final determination and further instructions.

Where rock is encountered and acceptable earth grounds cannot be accomplished by driving as described above, a grounding grid utilizing direct buried messenger cable or rods exothermically welded end to end shall be used to bond light poles and structures in continuous series to some point on a type of terrain that will permit obtaining an acceptable earth ground. Payment for this change shall be made by supplemental agreement.

Connections between rods and cable shall be made by exothermic welds with two coats of insulating varnish applied over welds and exposed cable.

### **621.07 PULL BOXES**

Pull boxes and covers shall be furnished as specified, and shall be located where designated on the plans. When required, excavation shall be performed as nearly as practicable to the outside dimensions of the pull box. After boxes are set to proper grades, excavated spaces around the boxes shall be backfilled with suitable material placed and thoroughly tamped in thin layers.

### **621.08 TRENCH**

Trenches shall have a minimum depth of 2 feet and shall not exceed 12 inches in width without prior approval of the Chief Engineer. Trenches located adjacent to and parallel with curbs or pavements shall not deviate more than 6 inches from the designated lines.

Sawcut lines in paved areas shall follow existing joints or grooves where possible and shall be pre-marked and approved by the Chief Engineer before sawing.

Trench backfill shall be placed in layers not to exceed 4 inches in thickness and compacted with mechanical tampers or other approved mechanical compactors as directed. Backfill material for trenches in areas of pavement, paved shoulders, or stabilized aggregate shoulders shall consist of granular material. Backfill material for trenches in other areas shall consist of suitable soil or granular material except that the material around and in the first 4 inches above the top of unit type duct-cable not encased in concrete shall not contain pieces larger than 1/2 inch..

### **621.09 CONDUITS**

Conduits shall be of the size shown in the contract documents and/or as specified herein and shall be concealed in the structure and under the roadways in compliance with all codes and standards cited in 621.02. The spacing and location of conduits shall conform to the dimensions shown on the drawings. All conduits shall be rigidly supported in an approved manner during pouring of concrete. Ends of all conduits shall be plugged or capped to prevent seepage of grout, concrete, water, or dirt into the conduit during construction.

Conduits shall be dripped at low points to prevent accumulation of condensate by sloping to boxes or installing "T" drains.

Where conduits pass through joints in concrete, approved expansion fittings shall be installed.

After installation, all conduits which will be left empty shall have a pull wire or cord installed. Pull wire or cord shall be made of corrosion resistant material with a minimum breaking strength of 200 lb. Rigid conduit shall be cleared after installation by drawing an iron shod mandrel through each section of conduit line between pull boxes as it is constructed. The mandrel shall not be more than 1/4 inch smaller than the internal diameter of the conduit and shall have a rubber or leather gasket slightly larger than the bore of the conduit. Defective conduits shall be repaired and the mandrel again drawn through.

Rigid metal conduit shall be installed with a minimum of bends and in no case shall the total angle of bends between outlet boxes of junction boxes exceed 180 degrees. Except for factory ells, the center line radius of conduit bends shall not be less than 12 internal diameters of the conduit. All bends shall be regular and symmetrical and the conduit shall not be flattened or distorted. The conduit shall be coupled and connected at the conduit fitting, junction and outlet boxes and expansion fittings, to assure electrical continuity throughout the entire metallic conduit system. Conduit shall be terminated in the junction boxes with insulated bushings to protect the wires. The use of running threads is prohibited and in lieu thereof an Erickson coupling shall be used.

Conductive compound shall be applied to all threaded ends.

#### **621.10 CONDUIT EXPANSION AND DEFLECTION FITTINGS**

Expansion Fittings – Conduit expansion and deflection fittings shall be installed as required where conduit crosses a structural expansion joint or open joint. Where expansion exceeds  $\frac{3}{4}$ inch, an expansion fitting shall be combined with the expansion and deflection fitting at the joint. Expansion fittings and expansion and deflection fittings shall be installed in place in accordance with the manufacturer's instructions.

#### **621.11 WIRING SYSTEM**

The Contractor shall furnish and install the type, and size of copper wire cables indicated on the plans and/or specified herein in strict compliance with all codes and standards cited in 621.02. Wires shall be drawn into place free from electrical and mechanical injury. No lubricant other than an approved type will be permitted to be used on wire installed in conduit. All wires shall be permanently marked with approved fiber tags as described to expedite tracing of circuits where device terminals are not otherwise identified. Wire shall be placed in rigid conduit unless otherwise specified and the total cross sectional area of the wire shall not exceed 40 percent of the conduit cross section area.

#### **621.12 CABLE CONNECTIONS**

All wire and cable shall be continuous from origin to destination without running splices in intermediate trays, pull boxes or manholes. In cases where splices are necessary because of long lengths, approval of splice locations shall be obtained from the Chief Engineer. Splices will not be permitted in conduits, ducts, or trays.

Splices in 600-volt rubber insulated wires and cables (where permitted) shall be accomplished by means of compression connectors. The connector shall be suitable for the size wire used and shall be of one piece tubular tinned copper construction. The indentation shall be such as to assure maximum electrical connection and sufficient physical strength. The connection shall be covered with approved electrical tape, half-lapped to a thickness not less than 50 percent greater than the conductor insulation.

If approved soldered connections are specified in the Special Provisions, each splice shall be covered with polyvinylchloride plastic insulating tape to provide insulation equivalent to that on the wire. Neoprene tape shall then be applied over the splice in half-lap wrappings to a thickness equivalent to the wire or cable outer jacket. Two final laps of polyvinylchloride tape

shall be applied and the splice shall then be painted with an approved air drying insulating varnish.

### **621.13 CIRCUIT IDENTIFICATION**

The Contractor shall furnish and install identifying tags on all circuit cables, in all junction boxes for line and light identification. Tags shall be as per 820.14. Identification markings, designated by the Chief Engineer, shall be stamped on the tags by means of small tool dies. Each tag shall be securely tied to the proper conductor by non-metallic core plastic. Self-adhesive plastic tags shall not be used unless approved by the Chief Engineer.

Each conductor passing through a junction or splice box or terminating in a street light or outlet shall be permanently identified as to circuit number and phase.

### **621.14 JUNCTION BOXES**

Junction boxes of the sizes and types specified shall be furnished and installed as shown on the plans. All junction boxes embedded in concrete structures shall be provided with drains. Any necessary deviation from the plans resulting from existing grade conditions shall be done only under the direct approval of the Chief Engineer in which case the method of installation for the junction box shall be determined by job conditions.

At each location in the electrical cable runs where the Contractor elects to make cable splices other than those shown on the plans or as specified, a junction box of the type indicated on the drawings for similar installations shall be furnished and installed at no additional cost to the District.

### **621.15 PAINTING ELECTRICAL WORK**

Cleaning and painting shall be done in accordance with 707 except that primer shall be zinc-chromate alkyd type conforming to the requirements of Federal Specification TT- P-645. Painted parts shall not be loaded for shipment until paint is thoroughly dry and in any case not less than 24 hours after final shop paint has been applied. No degree of tackiness shall be present at time of loading for shipment.

After electrical equipment installations are complete, all exposed shop painted surfaces shall be field painted with one coat of gray channel paint meeting requirement of Federal Specification TT-E-489C.. Also, all exposed conduits, supports, and other galvanized fittings or exposed parts thereof shall be field painted with one coat of zinc oxide galvanized primer paint meeting FS TT-P-641B, Type II. Before painting, all oil, grease or white oxide shall be removed by cleaning with oil-free naphtha solvent.

### **621.16 ELECTRICAL TEST**

The Contractor shall be responsible for furnishing all personnel and equipment required to perform the following tests and demonstrations successfully to the satisfaction of the Chief Engineer.

Not less than 30 days prior to commencement of each required electrical test, the Contractor shall submit to the Chief Engineer the types, styles, or catalog numbers of all testing equipment to be used for such tests. At the same time, the Contractor shall include a written certification

that the testing equipment was last calibrated not more than 60 days prior to the date when such tests are performed by a testing agency, whose qualifications as such are acceptable to the Chief Engineer.

- (A) **GROUND TEST.** Each ground rod, structure ground, and ground grid shall be measured for earth resistance immediately after being installed and before the ground wire is attached. If the earth resistance measurement exceeds 25 ohms, the Contractor shall proceed as specified in 621.06. Units of measurement for reporting shall be expressed in ohms.
- (B) **CABLE INSULATION TEST.** The insulation resistance shall be measured for each insulated cable, except pole and bracket cable, located in each primary feeder, secondary feeder, and distribution circuit, including duct- cable used in distribution circuits. The test shall be performed on each cable of each circuit with all ballasts disconnected and all connections to earth grounds, including ground rods and grounding connections to light poles, disconnected. Units of measurements for reporting shall be expressed in mega ohms. The cable insulation resistance shall exceed 10 mega ohms at 60° F.
- (C) **DEMONSTRATION.** The Contractor shall demonstrate to the satisfaction of the Chief Engineer that all:
  - (1) Lighting and control circuits are continuous and free of short circuits.
  - (2) Circuits are free from unspecified grounds.
  - (3) Circuits are properly connected in accordance with applicable wiring diagrams.
  - (4) Circuits are operable, which demonstration shall include the functioning of each control not less than 10 times and continuous operation of each lighting circuit for not less than ½hour and/or as specified in the Special Provisions.
  - (5) The Contractor shall record all faults, the method and date of correction of each, and submit a written report to the Chief Engineer in an orderly and approved format.
- (D) **COSTS.** All costs of labor, materials, equipment, electrical energy and incidentals required for performing the above electrical test shall be included in the contract price. Defects in materials or workmanship in the installation as disclosed by the tests shall be corrected or replaced by the Contractor without additional compensation.

#### 621.17 NAVIGATION LIGHTS

- (A) **Description.** This work shall include furnishing, installing and wiring of navigation lights complete and ready for service on structures, as shown in the contract documents or as directed by the Chief Engineer.
- (B) **Materials.** Conduit, boxes and fittings shall conform to the requirements of this Section and 820. Conductors and electrical components shall conform to the requirements of this Section and 820. No. 8 single-conductor wire shall be used from the connection at the service pole to the first junction box on the structure, and No. 10 single-conductor wire shall be used for other wiring.
- (C) **Electrical Service.** Power will be furnished within 100 feet of the end of the bridge by 120/240 volt, single phase, 60 hertz, three wire service. The Contractor shall furnish and

install a wood pole on which the power company will terminate its service lines. The Contractor shall install service entrance equipment on the wood pole in accordance with the requirements of SE-8. Safety switch shall be rated at 30 amps, 240 volts, two pole, solid neutral 120 AC and fused for 15 amps.

- (D) **Lights.** Lights shall be furnished and installed in accordance with the current rules and regulations for lighting bridges furnished by the U.S. Coast Guard (USCG) and shall be subject to USCG approval. Material and workmanship shall conform to the standards of NEC and the requirements of PEPCO. Lights shall be equipped with an automatic lamp changer with the capacity of four lamps and a step-down transformer to operate standard low voltage refocused lamps. Lights shall be arranged to be turned on and off automatically from sunset to sunrise. Lights shall be controlled by a photoelectric control. The control shall operate a two-pole, 30 ampere, normally opened, magnetic relay mounted in a NEMA 3R control center cabinet. The control for the lights shall be mounted on the service pole.

#### **621.18 MEASURE AND PAYMENT**

The unit of measure for Miscellaneous Electrical Work as specified in the contract documents will be the job.

Miscellaneous Electrical Work will be paid for at the contract lump sum price, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work.

## **622 FURNISHING BITUMINOUS MATERIALS**

### **622.01 DESCRIPTION**

Work consists of furnishing and delivering to District trucks, at the Contractor's or subcontractor's plant within the District, bituminous mixtures of the type specified, in such quantities as may be directed by the Chief Engineer and in accordance with provisions of these specifications.

A 24-hour notice of a change in location of the furnishing plant will be required except in case of extreme emergency such as mechanical failure in the plant.

### **622.02 MEASURE AND PAYMENT**

The unit of measure for Furnishing Bituminous Mixtures will be the ton. The number of tons will be the actual number of tons placed in District trucks and weighed on approved scales at the Contractor's plant. The scales shall be of sufficient size and dimensions to accommodate District hauling equipment. The net weight as determined from the gross and tare weights will be the weight on which payment is to be made. No payment will be made on individual batch weights.

The number of tons of Bituminous Mixtures will be made for at the contract unit price per ton, which payment will include coating truck beds, weighing trucks on approved scales, and all labor, materials, tools, equipment and incidentals necessary to complete the work.

## 623 CUT PAVEMENT CHANNEL

### 623.01 DESCRIPTION

Work consists of cutting a tapering channel approximately 4 feet wide in existing concrete or asphalt surface where a proposed new surface meets the existing pavement and as directed by the Chief Engineer.

The channel shall be formed by making a vertical neat line cut between 1 and 2 inches deep, approximately, as determined by the Chief Engineer, and carefully removing existing surface by chipping, stripping, etc. as directed by the Chief Engineer to form a gradual taper up to 4 feet wide and feathered to meet existing surface.

Where a new surface is to abut PCC pavement, the vertical cut line shall be made with a power saw designed for that purpose. Surfaces damaged from cutting procedures shall be repaired by the Contractor to the satisfaction of the Chief Engineer at no additional cost to the District. Vertical cut line will not be necessary in PCC pavement at gutter outer edge or if the Chief Engineer determines that a pavement joint may be used.

All tools used shall meet the approval of the Chief Engineer.

Disposal of removed materials shall be included as part of the work.

### 623.02 MEASURE AND PAYMENT

The unit of measure for Cut Pavement Channel will be the square yard of channel removed.

The actual number of square yards removed will be paid for at the contract unit price per square yard, which payment will include all operations necessary for proper removal, repair of pavement damage due to removal operations, and all labor, tools, equipment and incidentals necessary to complete the work.

## 624 ENGINEER'S FIELD FACILITIES

### 624.01 FIELD OFFICE

The Contractor shall provide and maintain a suitable field office for the sole use of the Chief Engineer and his representatives which shall contain not less than 600 square feet in gross area, with electricity, heat, adequate air conditioning during months of May through October, telephone service, running water, acceptable sanitary facilities, and daily janitor service, water connections and water meter cost to be charged to the Contractor. The Contractor shall provide acceptable access to the office. The field office shall include one or more office trailers with a minimum of two separate rooms of 120 square feet each and one conference room with a minimum area of 300 square feet.

Furniture and equipment for the office shall include two (2) fireproof, locking 4 drawer legal file cabinets, four (4) desks with locking drawers, four (4) swivel chairs, ten (10) folding chairs, one (1) hanging file for full-size drawings, one (1) 36 inch x 72 inch drawing table per trailer, one (1) new 35mm digital camera capable of displaying the date, one Canon 5000 copier or equivalent, three (3) Radio/telephones communications system carrying cases and one (1) FAX machine with dedicated phone line.

The field office shall include two (2) personal computer systems, complete with printers, color scanners and software, configured as follows:

Two IBM-compatible computers as manufactured by Dell, with minimum Pentium 4 (2GHz) Intel Compatible Processor, 512 MB Memory, 40 GIG HD, 32 MB Video card, 16 Bit Sound Card, 12x10x52 CDRW, 19" Flat Panel Color Monitor, 56 K Modem with complete DSL/Internet service, 87 Key Keyboard, 2 Button Mouse, 52xCDRW, Dual SCSI Controller, dual power supplies, 2 USB Ports, 1 Firewire Port, 1 Parallel Port, Video Port, two 10/100 NIC, Speakers, Fully Automated Library with minimum 2 Drives and Back-up rate of 216 GB per hour.

Two HP Laser Printers, 10-15 pages per minute, 2-3 Input Trays – 750 pages, monthly volume of 50,000 pages. Support legal, A4, letter, and 11x17 prints. Remote management and configuration, built-in network card, support laser technology, cables, toner, cartridge, developer and fuser kits, as needed.

The following software (new and unopened, latest available version) with full documentation:

Microsoft Windows, Microsoft Outlook e-mail/calendar ,

McAFEE Virus Scan V4.5 with up-dates, Microsoft e-mail/calendar client, ADOBE ACROBAT, Norton Utilities, WinZip Version, Microsoft Office Suite, dBase and Microsoft Fax.

The Scanner must be single pass, USB and Parallel Port Capable, 600 dpi to 2400 dpi optical resolution. Capacity at least 100 sheets. Support letter (8-1/2x11), legal and 11x17 paper.

The FAX Machine shall hold at least 250-500 sheets of plain paper. Memory buffer for minimum of 100 sheets. Provide confirmation page, 14.4-33.6 Data/FAX mode, Print/Copy in multitude, i.e., fine, superfine.

Miscellaneous items including Power strip, surge Protector and Security enclosure with lock computer, monitor and printer.

The equipment shall be maintained in such a condition that it is always available for immediate use. An adequate supply of batteries, film, copier paper, FAX paper and spring water shall be made available.

Adequate bathroom facilities with running water and drainage shall be maintained in each trailer.

Telephone service shall be supplied to each trailer including two separate phone lines and one fax line with a minimum of four (4) telephone instruments per trailer. A security alarm system shall be installed in each trailer.

The Contractor shall be responsible for District equipment placed in field offices, and shall promptly replace in kind or acceptably repair such equipment removed without permission or damaged.

The field office shall be set up in an acceptable location, equipped and made ready for use 3 work days prior to start of any work, and shall remain until field records pertinent to the project have been completed, not to exceed 30 consecutive calendar days after acceptable completion of all work and project close-out. The field office including facilities and furnishings supplied by the Contractor shall be removed when designated.

In addition, the contractor shall furnish, maintain and replace as necessary for the duration of the contract the following equipment for the exclusive use of the Chief Engineer:

- 2 Asphalt thermometers
- 2 Concrete thermometers
- 1 Set of sighting tees
- 1 Slump mold and tamping rod meeting requirements of AASHTO T 119
- 1 Chase indicator meeting requirements of AASHTO T 199
- 1 Pressure type air meter with necessary accessories meeting requirements of AASHTO T 152. The air meter shall be properly calibrated by an independent laboratory with certification furnished to the Chief Engineer
- 1 10' rolling straightedge
- 1 10' static straightedge
- 2 Calibrated measuring wheels

The Contractor shall furnish, construct and maintain walkways, platforms, ladders, stairways and other facilities of suitable character and adequate strength as necessary for all operations of construction inspection, and provide four (4) parking spaces at Field Office for the Engineer and his representatives.

At the conclusion of this project, all trailers, furniture, equipment and inspection facilities furnished under this item shall remain the property of the Contractor.

**624.02 MEASURE AND PAYMENT**

The unit of measure will be the job, with no actual measure taken.

Payment for Engineer's Field Facilities will be made at the contract lump sum price, which payment will include specified requirements stated above and in the contract documents. The first partial payment will not be made until all field facilities and associated utilities are complete and operating.

## 625 FIELD LAYOUT

### 625.01 GENERAL

Work under this item consists of furnishing all lines, including baselines /control lines, grades and measurements as shown on the contract documents and as directed by the Chief Engineer. The Contractor shall perform all Engineering layouts from baselines and benchmarks indicated in the contract documents and shall be responsible for all measurements in connection therewith. The Contractor shall verify all dimensions and elevations shown in the contract documents before construction begins and shall be responsible for the accuracy of the finished work.

Layout for all projects shall be performed by competent surveyors under the direction of a Registered Professional Civil Engineer.

The Contractor shall furnish at his expense all stakes, nails, equipment, tools, materials and labor as may be required in laying out any part of the work from the bench marks and base lines as shown in the contract documents. The Contractor shall protect and preserve established benchmarks and control points and make no changes in location without the approval of the Chief Engineer. Benchmarks and control points lost or destroyed or which require relocation because of necessary changes in grades or alignment shall be replaced and accurately located at the Contractors expense.

The Contractor shall accurately record all field notes and data in appropriate field books for the Chief Engineer. The Chief Engineer shall be informed when measurements are to be taken for the purpose of determining excavation and fill quantities. At the end of the project, all notes and field books shall become the property of the District of Columbia Department of Transportation.

Work shall be performed only using approved lines and grades; operations outside approved areas will not be included for measure and payment.

Stakes or marks the Chief Engineer sets for guidance shall be preserved by the Contractor. If, in the opinion of the Chief Engineer, stakes are displaced, removed or lost due to Contractor's negligence, they will be replaced by the Contractor at his own expense.

### 625.02 MATCH EXISTING WORK

The Contractor shall assume full responsibility for successfully carrying out the complete construction and the fitting of all members.. Where proposed work is to be fitted to existing work, the Contractor shall be responsible for checking all dimensions and conditions in the field. If the parts do not fit properly, the Contractor shall inform the Chief Engineer immediately and upon receipt of approval, make alterations to the new parts necessary to assure proper fit and connection in accordance with instructions of the Chief Engineer, at no additional expense to the District.

Prior to preparing his bid, the Contractor shall visit the project and carefully examine the existing conditions and then include in his bid, costs for making measurements necessary or convenient for the proper completion of the work.

**625.03 MEASUREMENT AND PAYMENT**

The unit of measure will be the job. No direct measure will be taken for this work. Payment for Field Layout will be made at the contract lump sum price, which payment will include all labor, tools, materials, equipment and incidentals necessary to complete the work as specified.

## 626 PROTECTION SHIELD

### 626.01 DESCRIPTION

Work shall consist of designing, furnishing, installing, relocating, maintaining, removing and disposing of a temporary protection shield along the length of the bridge. The shield shall be sized and designed to provide a floor sufficiently sturdy and tight to prevent equipment and materials of demolition and construction from falling through the shield and upon any portion of the area under the structure and the immediate vicinity. Care must be taken to ensure the safety of motorists, pedestrians, bicyclists and others who may be in the area under or adjacent to a structure. Required minimum horizontal and vertical clearances, as indicated in the contract documents, must be maintained.

The design, construction and maintenance of protection shields shall meet the requirements of 703.16, Falsework and Centering.

### 626.02 SHOP DRAWINGS

The shield shall be designed by a registered Professional Engineer and drawings shall bear his/her registration seal. Approval of said drawings shall be obtained from the District prior to commencing construction of the shield. Plans (including shop drawings and calculations) for the protection shield shall be submitted to the Chief Engineer for approval prior to start of demolition. This approval does not relieve the Contractor from the responsibility for the structural adequacy of the installation. Demolition shall not begin until the protection shield is completely erected and approved by the Chief Engineer.

Care shall be taken to ensure the safety of the traveling public using any roadways, railroads, pedestrian/bicyclist/horse trails that may pass beneath the structure.

### 626.03 CONSTRUCTION REQUIREMENTS

The protection shield shall be installed prior to start of any demolition and/or construction operations. The limits of the protection shield shall be equal to the full length of the superstructure, that is from back wall to back wall of abutments and shall cover all spans simultaneously, unless specifically exempted by the contract documents. The shield shall extend transversely at least 5 feet beyond the limits of construction for each particular phase, shall have barricades extending from the underside of the shield to an elevation of 6 feet above the floor of the shield and shall provide a minimum vertical clearance of 12'-6", or as indicated in the contract documents.

The floor of the protection shield shall be constructed to support a uniform live load of 85 pounds per square foot, or equivalent to the weight of the existing deck slab if that is larger. The side barriers shall be designed to resist a wind force of 50 pounds per square foot.

The protection shield may be installed and used in stages, if approved by the Chief Engineer. However, any portion of the structure where demolition and/or construction operations are taking place shall have a protection shield installed prior to the start of any work.

**626.04 MAINTENANCE**

The protection shield shall be inspected daily and shall be cleaned at the end of each working day. Regular maintenance shall be performed to ensure the structural adequacy of the installation and the ability of the flooring to retain construction debris.

**626.05 MEASURE AND PAYMENT**

The unit of measure for Protection Shield will be the job. No direct measure will be made.

Payment will be made at the contract lump sum price which payment will include the cost of design, shop drawings, fabrication, erection, staging, maintenance, dismantling, disposal and all labor tools, materials, equipment and incidentals needed to complete the work as specified

## 627 IMPACT ATTENUATORS

### 627.01 DESCRIPTION

This work consists of furnishing, assembling and installing permanent impact attenuators at designated locations in the District. Also included is replacement or refurbishment of damaged existing attenuator systems. The attenuator systems shall be furnished in the type and size specified and in the locations as shown in the contract documents. They shall be installed according to the manufacturer's recommendations and comply with the requirements of the National Cooperative Highway Research Program (NCHRP) Report 350, TL-3. All materials supplied with the attenuator systems shall be the same as tested and certified in the NCHRP report and by the Federal Highway Administration.

Shop drawings shall be submitted according to 105.02 (B) prior to installation of the attenuator system.

### 627.02 SAND-FILLED MODULE IMPACT ATTENUATOR

- (A) **GENERAL** – Work consists of furnishing and installing permanent attenuators of the frangible sand-filled inertial crash cushion module type to construct arrays at proposed locations shown on the contract plans, or restore damaged arrays at designated existing locations.
- (B) **MATERIALS** – Each module shall consist of an outer container, inner core, lid and sand. The modules shall be federal yellow or as shown on the plans. They shall be durable, waterproof, resistant to deterioration from ultra-violet rays, deformation from dynamic loadings due to vibration in the placement area and long-term stresses induced by thermal expansion and contraction and fill settlement.
- (1) Outer containers, inner cores and lids shall be an approved type.
  - (2) Sand shall conform to 804.02 dried to contain not more than one (1) percent moisture by weight. Sand shall also contain 3-5% sodium chloride as dry rock salt by weight.
- (C) **INSTALLATION PROCEDURES** – Sand modules shall be installed in accordance with the following procedures and the manufacturer's recommendations:
- (1) **New Locations** – The modules shall be placed on a concrete or asphalt pad or roadway pavement in the configuration as shown on the contract plans. Care shall be taken to ensure that the modules are placed in the specified sizes containing the proper weight of sand. Prior to placement, circles shall be painted on the pad in the proper location with the specified weight of sand indicated in pounds.
  - (2) **Existing Locations** – In attenuator repair contracts, sand modules shall be replaced in existing installations as they are damaged by vehicle impact. Within 48 hours of notification by the Chief Engineer, the Contractor shall commence operations for restoration of the site. The Contractor will be provided with a sketch of the site showing the number and orientation of the modules and weight of sand in each module. Prior to beginning work, the contractor shall photograph the damaged array to verify the condition.

The Contractor shall remove all damaged modules, dirt, debris and sand in the immediate area and dispose of these properly. Sand may be salvaged and reused if it

meets the requirements of (B) (2) above. Undamaged elements may be reused for temporary locations. Reusable lids shall be used to replace missing lids on existing modules. New modules shall be installed per manufacturer's recommended procedures. To insure that installations are restored as soon as possible, the contractor shall maintain an adequate supply of materials on hand. Unused modules and lids remaining at the end of the contract will be purchased from the contractor under the terms describe in Payment.

- (D) MEASURE AND PAYMENT** – The unit of measure will be per each. The total will be the number of new modules installed in new permanent locations and/or used to replace damaged modules in existing installations.

Payment for this item will be made at the contract unit price per each, which payment will include furnishing and installing new modules, removal and disposal of damaged modules, dirt, debris, and sand and all labor, tools, equipment and incidentals required to complete the specified work.

In replacement contracts, unused modules remaining after the conclusion of the project will be purchased from the contractor under the terms in Payment. Unused and undamaged modules paid for under this item will become the property of the District and be delivered to a designated storage yard. Installation of reusable lids is considered to be incidental work and allowances should be made when preparing bid price for sand modules.

### 627.03 QUAD BEAM IMPACT ATTENUATOR

- (A) GENERAL.** Work under this item consists of furnishing, assembling and installing Quad Beam Impact Attenuator systems of the size and of the type specified in the contract documents, complete in place at the locations shown on the contract drawings. The Quad Beam Attenuator systems shall be installed according to the manufacturer's recommendations and in compliance with the requirements of the National Cooperative Highway Research Program (NCHRP) Report 350, TL-3.

The Quad Beam Impact Attenuator shall be installed on a PCC pad of the size indicated on the manufacturer's drawings and shown on Standard Drawing 627.06.

- (B) MATERIALS.** Each Quad Beam Impact Attenuator, shall contain all external and internal parts necessary to give satisfactory service at the indicated site.

Components shall meet the following requirements:

- (1) Cartridges** – The Energy Absorbing cartridge boxes shall be of the number and arrangement indicated by the manufacturer for the intended application. Cartridge boxes shall be manufactured from a weather resistant plastic material. Cartridges boxes are of two types. One type shall contain paper honeycomb material, and the other type of cartridge box shall contain steel honeycomb material which shall be coated to minimize the effects of corrosion.

Each bay of the attenuator shall contain cartridge support brackets.

- (2) Diaphragms** – Diaphragms shall be made from 10 gage ASTM A 36 M steel quadruple corrugated beam. The length of each diaphragm shall be as required for each application. Two support legs shall be welded to channel which, in turn, shall be welded to the quadruple corrugated beam. Ski shaped plates shall be welded to

the bottom of the support legs. The diaphragms shall be designed to lock onto, and be guided by, an anchored and mounted support structure.

After fabrication, the diaphragms shall be hot dip galvanized in accordance with AASHTO M 111.

- (3) Fender Panels – Fender panels shall be fabricated from 10 gage steel quadruple corrugated beam guide rail sections. Each fender panel shall be drilled and slotted so that when assembled in the field, the front end shall be bolted to a diaphragm by means of the three horizontally placed 16 mm bolts, one of which shall be a “mushroom bolt.” The back end of each quadruple corrugated beam fender panel shall overlap and be connected to the fender panel of the next bay by means of mushroom bolts which shall fit through the long horizontal slot in the forward fender panel and the short vertical slot in the overlapped fender panel. (The bolt shall have a nut and square washer on the inside.) This permits movement, front to back, of one set of fender panels relative to the panels in the following bay.
- (4) Nose Wrap – The nose wrap shall be made of cross-linked, high density polyethylene molded to match the quad beam. It shall offer substantial yielding yet possess strong ability to recover to its original molded shape.
- (5) Backup – If a concrete back-up structure is not to be provided, a tension strut back-up assembly shall be provided. The details of this assembly shall be as indicated in the manufacturer’s or working drawings.
- (6) Hazard Marker – A hazard marker shall be wrapped around and securely attached to the nose of the attenuator facing oncoming traffic. The material shall be 0.025 gauge aluminum sheet and the legend shall be made from Type III High Intensity Reflective Sheeting.
- (7) Metal – All metal shall be AASHTO M 183 unless otherwise specified and galvanized per AASHTO M 111.

Fasteners – American Standard Regular Bolts, unless indicated otherwise in the contract documents.

Anchor bolts shall be ASTM A193 grade B7 grouted into the concrete pad with non-shrink grout.

- (C) **CONSTRUCTION REQUIREMENTS.** Installation of the attenuator shall be accomplished by the Contractor with experienced workers in accordance with the recommendations of the manufacturer.
- (D) **SHOP DRAWINGS.** Before fabricating the unit, shop drawings shall be submitted for approval by the Chief Engineer.
- (E) **MEASURE AND PAYMENT.** The unit of measure for Quad Beam Impact Attenuator will be per each unit installed, complete in place. Payment for Quad Beam Impact Attenuator will be made at the contract unit price per each, which payment will include fabricating, furnishing, assembling, PCC pad, concrete back-up structure, and installing the units and all labor, tools, materials, equipment and incidentals needed to complete the specified work.

## 628 EROSION AND SEDIMENT CONTROL

### 628.01 DESCRIPTION

This work shall consist of installing temporary measures to control soil erosion and sediment through the use of swales, dikes, sediment basins or traps, berms, silt fences, dams, paved chutes or flumes, riprap, fiber mats, netting, gravel, mulches, grasses or other devices or methods throughout the duration of the construction. Permanent control provisions, contained in the contract shall be coordinated with the temporary control provisions to the extent practical to assure economical, effective and continuous control throughout the construction and post-construction periods.

The District of Columbia Department of Transportation has adopted the D.C. Department of Health, Environmental Health Administration, Bureau of Environmental Quality Watershed Protection Division “-Storm Water Management Guide book” and “ Standards and Specifications for Soil Erosion and Sediment Control”. All work described herein shall be performed in strict conformance with the requirements specified in the above referenced manuals, of Best Management Practices and of Sections I (Temporary Structural Practices) and II (Permanent Structural Practices) as applicable of the DCRA Standards and Specifications and in accordance with the erosion control regulations in the current Title 21 of the D.C. Municipal Regulations (DCMR 21, Chapter 5). Latest copies of these referenced publications are available , from the Department of Consumer and Regulatory Affairs, One-Stop Permit Office, 941 North Capitol Street, N.E., Washington, D.C. 20002.

### 628.02 CONSTRUCTION REQUIREMENTS

Erosion and Sediment Control drawings and details, if included in the contract plans, may be used by the Contractor without submitting them for approval. If they are not part of the contract plans, or if the Contractor wishes to use an alternate approach, plans, details along with a written proposal and schedule for accomplishment of soil erosion and sediment control work shall be submitted to District of Columbia, Department of Health, Environmental Health Administration, Bureau of Environmental Quality Watershed Protection Division through the Department of Consumer Regulatory Affairs Office for approval. No work on land disturbing activities shall be started without the approved plans and until the control plans, schedules, and methods of operation have been reviewed and approved by the Chief Engineer.

The Chief Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, and by excavation, borrow and fill operations. The Chief Engineer may direct the Contractor to provide immediate permanent or temporary control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment, and to prevent damaging erosion or sediment deposits on neighboring lands. Such work may involve the construction of interim berms, dikes, dams, sediment basins, and slope drains, and use of interim mulches, mats, seeding, or other control devices or methods as necessary to control erosion and sedimentation. Fill and cut slopes shall be seeded and mulched as the excavation proceeds to the extent considered desirable and practicable. In some instances, incremental heights of slopes for sequential seeding and mulching will be specified.

The Contractor shall be required to incorporate all permanent erosion and sediment control features into the project at the earliest practicable time as outlined in his approved schedule. Temporary erosion and sediment control measures will be used as needed to correct conditions that develop during construction that were not foreseen during the design stage; as needed prior to installation of permanent control features; and as needed temporarily to control erosion or sedimentation that develops during normal construction practices but are not associated with permanent control features on the project.

Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion and sediment control features can follow immediately thereafter if the project conditions permit; otherwise, temporary control measures may be required between successive stages. Under no conditions shall the surface area of erodible earth material exposed at one time by clearing and grubbing exceed 50,000 square feet without approval of the Chief Engineer. The limitation will apply to clearing operations only unless exempted by the Chief Engineer.

The Chief Engineer will limit the area of excavation, borrow, and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent erosion and sediment control measures current in accordance with the approved schedule. Should seasonal limitations make such coordination unrealistic, temporary control measures shall be taken immediately to extent feasible and justifiable.

Under no conditions shall the amount of surface area of erodible earth material exposed at one time by excavation, borrow, or fill within the right-of-way exceed 50,000 square feet without prior approval by the Chief Engineer. This is in addition to the limitation on clearing and grubbing previously set forth.

The Chief Engineer may increase or decrease the surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow, and fill operations as determined by an analysis of project conditions. The roadbed area will be included in the surface area limitations if site conditions are judged to be unfavorable by the Chief Engineer. Erosion and sediment control measures shall be required on construction work outside the right-of-way where such work is necessary as a result of roadway construction. Included are borrow pit operations, haul roads and equipment storage sites within the District of Columbia.

The erosion and sediment control features installed by the Contractor shall be acceptably maintained by the Contractor until accepted by the District.

In the event of conflict between these requirements and laws, rules, or regulations of other Federal or State or local agencies, the more strict laws, rules, or regulations shall apply.

The Contractor shall be fined \$500.00 per day/per occurrence for failure to provide and/or properly maintain approved erosion and sediment control, as determined by the Chief Engineer.

### **628.03 MEASURE**

When Erosion and Sediment Control is listed as an item in the Pay Item Schedule, the unit of measure will be the job. No direct measure will be made whether or not the work is listed as a pay item.

**628.04 PAYMENT**

Payment for Erosion And Sediment Control, when it is listed as a pay item, will be made at the contract lump sum price, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein. Also included is the removal and disposal of all materials and restoration of the affected areas to the satisfaction of the Chief Engineer.

When Erosion and Sediment Control is not listed as an item in the Pay Item Schedule, no direct payment will be made and the cost of meeting the requirements of this work shall be reflected in and distributed among the various contract pay items.

Temporary erosion control measures required due to Contractor negligence, carelessness, or failure to install permanent controls as scheduled shall be at the Contractor's expense.

The Chief Engineer reserves the right to employ outside assistance or to use District forces to provide needed erosion control measures if the Contractor fails to do so. Such incurred direct costs plus project engineering costs will be charged to the Contractor.

## 629 LIGHT EMITTING DIODE (LED) ELECTRONIC SIGN

### 629.01 DESCRIPTION

Work under this item includes provision of acceptable design and operating requirements for Light Emitting Diode (LED) Electronic Signs, for display of specific messages, as required in the contract documents.

### 629.02 GENERAL REQUIREMENTS

All sign messages shall meet the standards contained in the most recent edition of the Manual on Uniform Traffic Control Devices, and Standard Highway Signs, unless otherwise indicated.

All sign messages shall be at least standard size, as defined in the Standard Highway Signs.

Signs shall have message display capabilities on both sides of the sign. Signs shall be capable of displaying one or more multiple messages on each side of the sign.

Sign messages shall be formed of rows of Light Emitting Diodes (LEDs).

Sign messages shall be clear and legible under any ambient lighting condition. When not illuminated, the sign message shall not be visible regardless of outside ambient lighting conditions.

Signs shall be no more than 8 inches in depth, excluding the visor. All sign messages shall be displayed at full intensity within a 15° cone of vision centered about the optical axis. Signs shall be provided in three (3) sizes:

1. 18 inches by 24 inches. This sized sign shall be clear and legible at distances up to 200 feet.
2. 30 inches by 30 inches. This sized sign shall be clear and legible at distances up to 500 feet.
3. 36 inches by 36 inches. This sized sign shall be clear and visible at distances up to 500 feet.

The sign assembly shall be designed to ensure that all internal components are adequately supported to withstand mechanical shock and vibration from wind ratings meeting AASHTO requirements for sustained winds of 80 mph with a 30% gust factor.

Unless otherwise specified, only red and lunar white LED shall be used to portray messages. Red shall be used to form all letters, one way arrows, and the left turn arrow in the symbolic No Left Turn sign.

Each sign delivered to the District of Columbia must include a full complement of six (6) drive modules in the driver rack. Drive modules not used for the sign application shall be retained by the District of Columbia for maintenance purposes.

Each sign delivered to the District of Columbia must include two (2) visors; one to mounted on the sign during field installation, and one to be used for future maintenance purposes.

### 629.03 SIGN HOUSING CONSTRUCTION

**General.** The sign housing shall be fabricated from extruded aluminum with a minimum thickness of 0.125 inches.

Signs featuring messages on one side of the sign only shall feature a flat aluminum panel welded to the back of the housing.

All housing corners and seams shall be heli-arc welded to provide and ensure a weatherproof seal around the entire housing.

The housing shall meet the requirements of NEMA Type 4 enclosures

The housing shall be reinforced as necessary at proper locations to provide structural integrity.

Each sign housing shall include four (4) screened holes, 3/16 inch in diameter at the bottom of the housing.

**Housing Door.** Each sign housing shall include an extruded aluminum door with minimum thickness of 0.125 inches.

Each door shall be appropriately welded and reinforced for structural integrity and to prevent excessive door flexure when open.

Each door shall include a drip edge around the mating flange.

The extruded aluminum sign door shall be hinged on the left side with a continuous, full length stainless steel hinge.

Each door shall be locked on the right side of the sign using a minimum of two (2) Number 3 stainless steel ¼ turn link-locks to allow tool free access to the interior of the sign.

Door gaskets shall be 3/16" x 1" neoprene and shall provide a continuous weatherproof seal between the door and the housing.

One side of the door shall be removable to allow access to the sign face.

A retaining rod shall be provided to hold the front door in the open position.

**Mounting Hubs.** Each sign housing shall feature mounting hubs on the top and the bottom of the sign for cable access and to facilitate mounting and affixing to poles.

Mounting hubs shall be cast aluminum alloy with 1-½ inch standard pipe threads.

Hubs are to be mounted on a gasket to the sign housing by three 5/16 x 1 inch stainless steel hex head bolts and nuts.

Gaskets shall be serrated and shall lock into the housing to prevent sign mis-alignment.

The connection between the sign housing and the mounting hubs shall be waterproof.

The holes in the sign housing at the mounting hubs shall be 1-½ inches in diameter and shall be machined to eliminate burrs that may snag electrical cables.

**Visor.** The entire housing shall feature a visor that extends over the top and both sides of the sign.

Each visor shall be 0.063 inch thick aluminum.

Each visor shall be 6 inches in length and shall extend off the housing door.

Each visor shall be affixed to the sign housing using stainless steel screws.

**Face Lens.** The face lens shall fit into the door. The entire sign face shall be protected by a ¼ inch clear polycarbonate lens in the door frame.

The lens shall be non-glare matte-finished polycarbonate with UV resistant surface treatment and light transmission properties of at least 82%.

The lens shall minimize all unwanted reflections.

The entire display face, including the face lens and the LED Message Display Board, shall be assembled as a one-piece self-contained module that can be easily removed from the sign housing without the need of any tools.

**Sign Finishes.** The entire sign housing shall be acid etched and painted with two (2) coats of zinc chromate primer.

The interior of the sign housing assembly and the inside of the visor shall be painted with two (2) coats of high quality flat black enamel.

The exterior of the sign housing, sign door frame, and the outside of the visor shall be painted with two (2) coats of high quality enamel, colored battleship gray ( MVC 1417, GE LEXAN No. 7040Z, Federal Color No. 16099). In certain specified applications, Federal Black, Color No. 27038 may be substituted for battleship gray.

**Vents.** Two air vents shall be installed on the sides of the housing; one at the lower lefthand side and one at the upper right hand side of the sign. Vents shall be designed to prevent moisture or rainfall from penetrating the housing and both shall have replacable air filters to keep the enclosure dust-free.

**Modularity.** The sign construction shall be of a modular configuration consisting of hand-removable, self-contained modules, message display, rack-mounted individual message drivers, driver rack assembly and the housing shell.

**Fasteners and Hardware.** All mechanical fasteners and hardware shall be corrosion-resistant stainless steel.

#### 629.04 ENVIRONMENTAL REQUIREMENTS

The sign shall be rated for use in ambient operating temperatures in the range of minus 40° C (minus 40° F) to plus 74° C (plus 165° F). The LED display module shall be completely sealed against dust and moisture intrusion in conformance with NEMA Moisture Resistant Standard 250-1991, Section 4.7.2.1 and 4.7.3.2 for Type 4 enclosures to protect all internal components.

#### 629.05 CHROMATICITY

The measured chromaticity coordinates for red, yellow, green, lunar white and Portland orange shall conform to the chromaticity requirements of Section 8.04 and Figure 1 of the

VTCSH Standards. Chromaticity requirements shall remain unchanged over the input line voltage of 95 VAC to 135 VAC.

The measured chromaticity coordinates of LEDs shall conform to the following requirements:

RED:	Y: not greater than 0.308 or less than 0.998 – X:
YELLOW:	Y: not less than 0.411, not less than 0.995 – X, not less than 0.452.
GREEN:	Y: not less than 0.506 – 0.519 X, nor less than 0.150 + 1.068 X, not more than 0.730 – X.
PORTLAND ORANGE:	Y: not greater than 0.390, not less than 0.331, nor less than 0.997 – X
LUNAR WHITE:	X: not less than 0.290 nor greater than 0.330
	Y: not less than 1.5X-0.175, or greater than 1.5X-0.130

#### 629.06 LED MESSAGE DISPLAY BOARD

The message display shall consist of LEDs mounted on a PCB Matrix with a matte black solder mask. The universal PCB matrix shall have the capabilities to display sign messages conforming to MUTCD requirements. LEDs shall be arrayed on the mat to depict the required message.

The LEDS shall be arranged in a manner to form the outline of the symbols and shall be distributed evenly along the message outline.

The maximum distance between consecutive LEDS shall be .550 inches and shall vary by more than 10%.

The PCB matrix shall have a maximum thickness of 0.93 inches.

The PCB shall have a component identifier screen.

The red LEDS shall be of the latest Alln GaP Technology; the lunar white LEDS shall be of the latest In GaN Technology.

The minimum nominal luminous intensity of the LEDs shall be 6,000 mcd at 20mA.

The individual LED light sources shall be interconnected so that a catastrophic failure of a single LED will result in a total loss of not more than 5 % of the signal light output.

There shall be no electronic components visible from the front of the display. The display face shall consist solely of LEDs mounted on a mat black PCB.

The rear side of the PCB shall be protected by a molded polymeric back cover to seal and protect it from any possible damages.

The display PCB with back cover shall fit into the front door which consists of an aluminum frame and face lens.

The display module shall have a multi-conductor cable with an individual 2-pin connector for each message.

**629.07 DRIVE CIRCUITRY**

The sign shall feature one individual LED drive module for each message. A drive module shall be provided for each individual symbol, for each message line and for each overlapped message on any given line. The drive modules shall be designed to be rack-mounted as per standard industry dimensions of 6.5 inches x 4.5 inches.

The drive modules shall consist of a PCB (0.62 inches in thickness) with an aluminum front plate and handle, as used for inductive loop detectors.

The drive modules shall drive the LEDs at a DC current not exceeding the maximum rating as recommended by the LED manufacture (20 mA).

The drive modules shall regulate the LED drive current to compensate for line voltage fluctuations over a range of 95 VAC to 135 VAC. The luminous output of the display shall not vary more than 10% over the voltage range and shall not be perceptible to the human eye.

The drive modules shall be fused and shall include voltage surge protection to withstand high-repetition noise transients and low-repetition high-energy transients as stated in section 2.1.6, NEMA Standard TS-2, 1992.

The on-board circuitry shall meet FCC title 47, sub-part B, section 15 regulations concerning the emission of electronic noise. The circuitry shall ensure compatibility and proper triggering and operation of load switches and conflict monitors in signal controllers currently in use in the District of Columbia.

The drive modules shall have a capacity of 25 watts. The modules shall be designed to maintain a constant LED drive current regardless of the outside temperature, within a range of minus 30 ° C to + 40 ° C.

The drive modules shall be designed to dim automatically based on the ambient light level. In order to reduce the long-term degradation of LEDs, the automatic dimming circuit shall be tuned to reduce the light intensity of the display by 35%. The dimming circuit shall have a 30 second delay to prevent interference caused by shadows or headlights. LED drive current shall be regulated effectively when in the dimmed state.

The drive modules shall be designed to monitor the proper operation of the message display and to provide an alarm if the display is not operational. The drive modules shall be capable of providing a confirmation or alarm signal which can be configured for 120 Vac or 24 Vdc PLC application (sinking or sourcing type). In the event of a malfunction in one sign drive module rendering that part of the message blank, the monitoring circuit shall detect the malfunction and disable all other drive circuits displaying a blank sign to prevent any possible conflict.

Drive modules shall include a green LED for power status and a red LED for alarm status.

All electronic components shall be standard industry type, available from wholesale electronic distributors.

**629.08 DRIVER RACK ASSEMBLY**

The driver rack assembly shall be a single part self contained module consisting of an interconnect PCB and an ionized aluminum frame. The driver rack shall have the capacity to house up to six (6) drive modules.

The aluminum rack shall be vented from top to bottom and shall include latches to secure the modules in place. The rack assembly shall be secured in the sign enclosure by four (4) captive type spring-loaded thumbscrews. The entire assembly shall be removable in less than one minute without the need of any tools.

The interconnect PCB shall include connectors for 6 drive modules and 6 display messages. The interconnect PCB shall include terminals for all field wiring, 120VAC controls, external photocell, and alarm signals. The field wiring and display terminals shall be spring-loaded, anti-vibration type.

All interconnections within the sign shall be accomplished through the PCB. No internal wiring shall be permitted with the exception of a single cable for the message display.

The interconnect PCB shall be equipped with a 10 position binary switch for each message to allow the drive current to be calibrated for each individual message and to increase drive current in case of long-term degradation to LEDs. Each step shall provide a 1mA increment up to a maximum of 25mA.

All connectors and terminals shall be identified via the silk screen identifier on the surface of the PCB.

The driver rack assembly shall be mounted on the left side of the sign enclosure.

All PCBs shall be mounted vertically to facilitate air-cooling and to prevent collection of dust and moisture.

### **629.09 ELECTRICAL REQUIREMENTS**

The sign power rating shall not exceed 15 watts per message. Each sign shall operate from a 60HZ  $\pm$ 3HZ AC line over a voltage ranging from 95 volts to 135 volts. Fluctuations in line voltage shall have no visible effect on the luminous intensity of the sign message. The operating voltage of the LEDs shall be 120 volts AC. All operating parameters shall be measured at this voltage. Sign circuitry shall prevent perceptible flicker to the unaided eye over the 95 to 135 volt range.

The sign's on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients as stated in Section 2.1.6 of the NEMA Standard TS-2, dated 1992.

Each sign and associated on-board circuitry shall be in compliance with FCC noise regulations and must meet FCC Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

Each sign shall be operationally compatible with controller assemblies and peripheral equipment including solid state load switches, flashers, and conflict monitors currently in use in the District of Columbia. Current controller specifications are available for review at the specific request of the Contractor or vendor. Each sign shall feature control circuitry to prevent current flow through the LED module in the off state to avoid any false indication as may be perceived by the human eye during daylight and evening hours.

All LEDs will have an expected lifetime of 100,000 hours.

**629.10 WARRANTY**

All warranties shall pass from the Contractor to the District of Columbia following final acceptance of the sign after it is placed in service.

Individual LEDs shall be warranted against defects in materials and workmanship for a period of 60 months.

The sign assembly shall be warranted against defects in materials and workmanship for a period of 24 months.

The warranty period for all products shall begin on the date the sign is placed into operational service in the District of Columbia or ninety (90) calendar days after the sign is delivered to the District of Columbia, whichever occurs first.

Replacement signs, LEDs or component parts shall be provided on a one for one basis after receipt by the manufacturer of the failed unit. Replacement of signs, LEDs, or component parts which failed while under warranty shall occur at no cost to the District of Columbia.



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## 701 PILING

### 701.01 DESCRIPTION

Piles shall be of timber, precast reinforced concrete, precast prestressed concrete, cast-in-place concrete with steel casing or steel H-beam, as specified, constructed and driven in accordance with these specifications, and as indicated on the contract documents or as directed by the Chief Engineer.

### 701.02 MATERIALS

- (A) The materials for piles and splices shall be as indicated on the contract documents and shall conform to 816.
- (B) Concrete shall conform to 817.
- (C) Reinforcement shall conform to 812.02.
- (D) Prior to driving any pile, the Contractor shall submit written certification from the manufacturer that the materials meet the requirements of the specifications. Certified mill test reports shall be submitted for steel piles.

### 701.03 PREPARATION FOR DRIVING

- (A) In areas where piles are to be driven and excavation or embankment construction is to be performed, the excavation or embankment shall be completed before the driving of piles begins.
- (B) When piles are located in embankment fill 5.0 feet or greater in depth, an augured hole through the embankment will be required for each pile location. The augured hole shall not be carried into the original material beneath the embankment construction. Holes shall be drilled with a power auger. Holes shall be clean and equal to or slightly larger than the maximum cross-sectional dimension of the pile. If left overnight, holes must be protected or be re-augured the following day. Augured holes shall be filled with sand or other suitable material after driving piles.

### 701.04 DRIVING

- (A) **GENERAL.** Piles, including Length Test Piles and Load Test Piles if required, shall be driven only in the presence of the Chief Engineer. Permanent piles shall not be driven until test piles for the particular section have been driven, tested and approved by the Chief Engineer. No pile shall be driven within 20 feet of new PCC foundations which have cured for less than 14 days. If a load test is required, permanent piles shall not be driven until the load test data have been analyzed and permission to drive permanent piles is obtained from the Chief Engineer. No pile driving is permitted within a radius of 100 feet of any pile load test during load testing operations. The hammer used to drive permanent piles shall be of the same size, type and manufacture as the hammer used to drive length test piles. Each pile shall be driven continuously from the start of driving until the bearing capacity is secured. Unless specifically authorized by the Chief Engineer, intermittent driving to secure increased bearing values will not be permitted. Piles shall be stored and handled so as to avoid damage

- (B) **PRACTICAL REFUSAL.** Piles shall be driven at least to minimum pile tip elevations and pile design loads indicated in the contract documents. If the indicated pile design load is not attained when the minimum pile tip elevation is reached, driving shall continue until the Chief Engineer is satisfied that the pile design load is attained. If extremely hard pile driving conditions exist and/or “practical refusal” is reached at a elevation higher than the specified minimum pile tip elevation, the pile tip elevation may be modified, but only with prior approval of the Chief Engineer. Unless otherwise determined by the Chief Engineer, “practical refusal” shall be defined as the conditions reached when the actual driving bearing capacity of piles is as follows:
- (1.) 3.0 times pile design load for design loads of 40 tons or less per pile.
  - (2.) 2.5 times pile design load for design loads greater than 40 tons per pile.
- (C) **HAMMERS.** Piles may be driven with approved diesel hammers, gravity hammers, air hammers or with single or double-acting steam hammers of such capacity and in such manner that the piles will be driven to the depths and load capacities required without injury or damage to the piles. The use of gravity hammers on concrete piles will not be allowed. Unless specifically outlined on the plans, the following minimum requirements will apply:
- (1) Hammers for Timber or Steel Piles. Timber or steel piles shall be driven with an approved steam, air, diesel or gravity hammer.
    - (a) Steam, air or diesel hammers shall develop an energy of not less than 7,000 foot-pounds per blow when driving timber piles and 15,000 foot-pounds per blow when driving steel piles.
    - (b) Gravity hammers shall weigh not less than 3,000 pounds and not less than the weight of the driving head and pile. The height of fall shall be so regulated as to avoid injury to the pile and in no case shall exceed 15 feet.
  - (2) Hammers for Precast Concrete, Steel Shells or Steel Pipe Piles. Precast concrete, steel shells or steel pipe piles shall be driven with an approved steam, air or diesel hammer, which shall develop an energy of not less than 15,000 foot-pounds per blow and not less than 1 times the weight in pounds of the pile being driven.

If required pile penetration is not obtained with hammers meeting above requirements, hammers shall be provided which give the greater output needed. Sonic or other type hammers may be used only with prior written approval of the Chief Engineer. The hammer to be used for driving permanent piles shall be the same that was used to drive the test piles. If the Contractor changes hammers, the Contractor shall drive additional test piles at the Contractor’s expense, before driving the permanent piles, even if the energy ratings of the hammers are identical.
- (D) **LEADS.** Piles shall be held in fixed leads during driving. In lieu of fixed leads the Contractor may use, with the prior approval of the Chief Engineer, any method in which the pile is properly guided and supported and the hammer guided and rigidly supported independently of the pile. Leads shall be adjustable as to batter and shall either be telescopic or of such length as to extend from the highest point to the lowest point which the hammer must travel. If swing leads are used, all piles shall be driven with templates of type, size and in locations approved by the Chief Engineer.

- (E) **FOLLOWERS.** Followers meeting the approval of the Chief Engineer may be used if necessary in driving of piles, but shall be operated in conjunction with the telescopic or extension leads. When a follower is used, one pile in any group of ten shall be a long pile driven without a follower, and shall be used as a test pile to determine the average bearing power of the group. The intent of this specification is that the leads and hammer, or the leads and a suitably braced follower, follow the pile head and support it throughout the entire driving period.
- (F) **ACCURACY OF DRIVING.** All piles shall be located accurately as to position and batter; and any pile driven out of place or injured in driving shall be pulled and redriven or replaced as may be directed by the Chief Engineer, at the sole expense of the Contractor. No variation greater than 1/4 inch per foot from the vertical or specified batter will be acceptable, and the top of each driven pile shall not be out of position by more than 6 inches.
- (G) **BEARING CAPACITY OF PILES.** All piles shall be driven to the minimum bearing capacity specified on the plans or in the Special Provisions. Determination of pile capacity, except for the load tested pile, will be based on the following formulae:

$$P = \frac{2WH}{S + 1.0} \quad \text{for gravity hammers}$$

$$P = \frac{2WH}{S + 0.1} \quad \text{for single-acting power hammers}$$

$$P = \frac{2(E)}{S + 0.1} \quad \text{for double-acting power hammers}$$

W =	Weight, in pounds, of striking parts of hammer
P =	Safe bearing capacity in pounds
H =	Height of fall in feet
E =	Energy per blow, actual foot pounds
S =	Average penetration in inches per blow for the last 5 to 10 blows for gravity hammers, and for the last 10 to 20 blows for power hammers.

The above formulae are applicable only when:

1. The hammer has a free fall.
2. The head of the pile is not broomed or crushed.
3. The penetration is reasonably quick and uniform.
4. There is no appreciable bounce of the hammer after the blow.
5. A follower is not used.

In the event of hammer bounce, twice the height of the bounce shall be deducted from H to determine its value in the formulae.

The manufacturer's rated energy per blow will not be used in bearing capacity formulas; this energy will be determined by the Chief Engineer. No allowance will be made for hammer bounce or spring action in computation of energy per blow. For

diesel hammers, the energy rating to be used in bearing capacity formulae shall be as follows:

1. 85 percent of the manufacturer's rated energy per blow for a double acting (enclosed ram) hammer.
2. 75 percent of the manufacturer's rated energy per blow for a single-acting hammer.

The foregoing formulae shall be used as guides only. In all cases the Chief Engineer will be the sole judge as to the final tip elevation of all piles.

- (H) CUTOFFS AND CLEANUP.** Cutoffs shall be made in one plane at the correct elevation or elevations shown on the plans. In general, the length of pile shall be sufficient to permit the complete removal of all material injured by driving. All cutoffs shall become the property of the Contractor and shall be removed from the site. Any material forced up between the piles and all loose and displaced material around the piles shall be removed to the correct elevations, leaving clean solid surfaces to receive the concrete. Such material is to be removed at the Contractor's expense.
- (I) LENGTH OF PILES.** Unless otherwise outlined on the plans, piles shall be driven to a minimum depth of penetration of 10 feet, measured from the cutoff elevation to the tip of the pile, except that when driven in fill areas, the minimum depth of penetration shall be 10 feet below undisturbed ground.

#### 701.05 LENGTH TEST PILES AND LOAD TESTS

- (A) LENGTH TEST PILES.** When required, the Contractor shall test piles at the locations shown on the plans or designated by the Chief Engineer. These piles shall be of sufficient length to provide for any variation in soil conditions. They shall be driven to the requirements as specified herein. Piles thus driven, if in a planned pile location and if a satisfactory bearing is obtained, shall become permanent structure piles. The length test piles shall be driven to practical refusal as set forth in 701.04(B) and evaluated by the Chief Engineer. The hammer used for Length Test Piles shall be of the same type and manufacture that the Contractor proposes to use for all pile driving under this contract.
- (B) LOAD TEST PILES.** No load test piles shall be driven until length test piles are driven to practical refusal and evaluated by the Chief Engineer. Load tests shall be performed at locations and upon piles shown on the plans or as designated by the Chief Engineer. The number of pile load tests may be increased or decreased by the Chief Engineer. Piles selected for load testing shall be tested as individual vertical foundation piles driven to the minimum bearing capacity called for in the contract documents, to determine the relationship between load applied and pile reaction.
- (1)** The hammer used for load test piles shall be of the same type and manufacture that the Contractor proposes to use for all pile driving under this contract. equipment (i.e. jacks, pressure gauges, etc.) have recently been properly calibrated The method of loading, bracing, etc., and the facilities for observing the load test and measuring settlements will be at the option of the Contractor; however, prior to testing, the Contractor shall submit plans for approval showing in sufficient detail the methods and equipment proposed for use.. The bracing for the pile shall be completely in

place before any test load is applied and shall remain in place until after the completion of the load test. Loading shall not be started until 48 hours after completion of driving, and is subject to the Chief Engineer's approval. Prior to any loading application, the Contractor shall submit to the Chief Engineer certification from an acceptable testing laboratory that all appropriate equipment (i.e. jacks, pressure gauges, etc.) have recently been properly calibrated. The certificates will not be acceptable if more than 6 months old.(2) The Contractor shall furnish the Chief Engineer with adequate facilities for making settlement readings 24 hours per day, including lighting and shelter from rain, wind and direct sunlight in the instrumented area. The Contractor shall assign an employee, who fully understands loading and test equipment procedures, to be present during each entire load test.

- (2) The Contractor shall be responsible for each load test, and any pile failing to meet the Chief Engineer's approval, whether because of damage while driving or any other reason, shall be withdrawn, and a new pile driven at the Contractor's expense. All movement readings will be recorded by the Chief Engineer and the Contractor shall neither add nor remove loading increments until permitted by the Chief Engineer.
- (3) If a hydraulic jack is used, the capacity shall be not less than 225 percent of the pile design load indicated on the plans. The detailed method of applying, measuring and recording load tests shall be submitted in writing to the Chief Engineer for approval prior to pile testing and shall include sufficient sketches to fully illustrate proposed method. Any loading platform used shall have a safe capacity of 4 times the pile design load indicated on the plans. If steel H piles are used for reaction or anchor piles, the jacking or reaction beam shall be held down by positive rigid connections to steel H sections. Cable tie-downs will not be permitted. The distance from the test pile to any reaction pile shall be not less than 5 feet measured from center to center. If reaction or anchor piles are driven at permanent pile locations and meet all specification requirements, payment for such piles will be made at the contract price for Piles. Reaction or anchor piles which are not permanent piles as determined by the Chief Engineer shall, at the direction of the Chief Engineer, be left in place or be pulled out and the hole backfilled with sand.
- (4) The test load shall be concentrically applied as near the ground surface as practicable and by such method that the test load acting on the pile at any time may be definitely determined and controlled.
- (5) If in the opinion of the Chief Engineer the test pile is found to be in satisfactory condition at the conclusion of the load test, it shall be completed and incorporated into the structure as a permanent pile. If the Chief Engineer determines the test pile has not met requirements, the pile shall be withdrawn and a new one driven or spliced as needed and driven to required depth after pile tip elevations are determined from new test piles. Upon completion of the test, all temporary work in connection therewith shall be removed. The heads of the piles tested shall be cut to the proper elevations required to conform to plans and the resulting cutoffs shall become the property of the Contractor and be removed from the site.

(6) Prior to driving a pile to be load tested, the Contractor shall submit to the Chief Engineer written details outlining his chosen method for the pile load tests. The following are three methods for performing the pile load tests:

(a) **STANDARD LOAD TEST.** The load shall be applied in sequential increments of 25, 50, 75, 100, 125, 150, 175 and 200 percent of the pile design load indicated on the plans.

(1) **Measurements.** Methods satisfactory to the Chief Engineer for obtaining measurements of vertical movements shall be furnished. Readings of these vertical movements made to an accuracy of 0.001 inch shall be taken before and after the application of each new load increments and 2, 4, 8, 15, 30, 60 minutes, and every 2 hours until application of the next load increment. Additional load increments shall not be applied until rate of settlement caused by previous load increments less than 0.01 inch in one hour, or until at least 2 hours have elapsed, whichever occurs first. Full test load of 200 percent of the pile design load indicated on the plans shall be maintained on the pile for a minimum period of 48 hours, or such additional time as stipulated by the Chief Engineer. Settlement readings will be taken at the beginning and at the end of the period, and at 4 hour intervals during the period.

(2) **Length of Test.** If all settlement has ceased or if no progressive settlement occurs during the last 4 hours of the 48 hour test, the unloading of the pile may begin. However, if any progressive settlement is observed during the last 4 hours of the 48 hour test, the full load test shall be maintained on the pile for an additional 12 hours; during the last 4 hours of this additional period the pile shall not show continued settlement.

(3) **Unloading.** During the unloading of the pile, the rebound shall be measured when the load remaining on the pile amounts to 75, 50, 25, 10, and 0 percent of the full test load, which decrements of load released at no less than one hour intervals. Rebound readings shall be taken immediately before and after removal of each decrement. Final rebound readings shall be taken 24 hours after the entire test load has been removed; or at more than 24 hours if the Chief Engineer determines that the pile continues to rebound slowly.

(4) **Safe Allowable Load.** Unless otherwise evaluated by the Chief Engineer, the safe allowable load will be considered as 50 percent of the load which, after a continuous application, for a minimum period of 48 hours and for extended periods if required by the Chief Engineer, produces a net permanent settlement nor greater than 0.25 inch measured at the top of the pile.

(b) **QUICK LOAD TEST.** Quick Load test shall be in accordance with ASTM D-1143.81.

The load shall be applied in increments of 10 to 15 percent of the proposed design load with a constant time interval between increments of 2-1/2 minutes. Load increments shall be added until continuous jacking is required to maintain

the test load or until 200 percent of the pile design load is reached, whichever occurs first, at which time the jacking shall be stopped. After a 5 minute interval, the full load shall be removed from the pile in four approximately equal decrements with 5 minutes between decrements. Readings of time, load and settlement shall be taken and recorded immediately before and after the application of each load increment and at intermediate time intervals as directed. After the maximum load has been applied, readings shall be taken and recorded when the jacking is stopped, after 2-1/2 minutes, and again at 5 minutes thereafter. Readings of time and rebound shall be taken and recorded after all load has been removed, after 2-1/2 minutes, and again at 5 minutes thereafter.

**(c) HIGH STRAIN DYNAMIC LOAD TEST.**

**(1) General.**

- (a)** Dynamic testing involves attaching at least two strain transducers and two accelerometers to the pile near the pile head during initial driving or at a convenient location during restrike testing. A cable connects the gages near the pile head with the Pile Driving Analyzer located a safe distance from the pile, but not more than 300 ft from the pile.
- (b)** The Contractor shall secure the services of a Dynamic Testing Consultant. Dynamic testing shall be performed on the load test piles during the final 10 to 40 ft for Timber or steel piles and the full length for concrete piles of initial driving and/or during re-strike driving a minimum of one to two days after initial driving.
- (c)** Dynamic pile testing may also be performed on an additional 5% of the production piles as directed by the Chief Engineer. The production pile testing shall be performed during re-strike to monitor hammer and drive system performance, assess pile installation stresses and integrity, as well as to evaluate pile capacity.

**(2) Equipment and Personnel.**

- (a)** All equipment necessary for the dynamic monitoring such as gages, cables, etc., shall be furnished by the Dynamic Testing Consultant. The equipment shall conform to the requirements of ASTM D-4945-00, Standard Test Method for High Strain Dynamic Testing of Piles and AASHTO T 298-99, High Strain Dynamic Testing of Piles.
- (b)** An engineer with a minimum 5 years of experience and/or who has achieved Basic Level or better on the Foundation QA Examination for Providers of PDA Testing Services shall be in charge of Pile Driving Analyzer (PDA) operation and of result interpretation, either on site or by remote connection.
- (c)** To prepare the pile for transducer attachment, either a generator or a DC drill of sufficient power shall be available. A hammer drill is required for preparation of concrete piles.

**(3) Execution**

- (a) Construction Access.
- (1) Prior to lifting the pile to be dynamically tested, the Contractor shall provide a minimum of 3 ft of clear access to 180 degree opposite faces of the pile for pile preparation. The Dynamic Testing Consultant or the Contractor's personnel shall then drill and prepare holes for gage attachment.
  - (2) The Contractor's personnel shall attach the gages to the pile after the pile has been driven to the required penetration depths. Driving shall then continue using routine pile installation procedures. When the level of the gages is within 1 ft. of any obstruction endangering the survival of sensors or cables, driving shall be halted to remove the gages from the pile. If additional driving is required, the obstruction shall be removed or the pile shall be spliced and the gages shall be reattached to the head of the next pile segment prior to the resumption of driving.
- (b) Testing Procedures.
- (1) Preconstruction Wave Equation Analyses. Ten days prior to driving the load test piles, the Contractor shall submit the pile and complete driving equipment data form to the Chief Engineer. The Dynamic Testing Consultant shall use the submitted information to perform wave equation analyses and shall prepare a summary report of the wave equation results. The wave equation analyses shall be used to assess the ability of the proposed driving system to install the pile to the required capacity and desired penetration depth within the allowable driving stresses.
  - (2) Approval of the proposed driving system by the Chief Engineer shall be based upon the wave equation analyses indicating that the proposed driving system can develop a pile capacity of the pile design load times 2.5 at a driving resistance not greater than 20 blows per inch within allowable driving stress limits. The hammer should also be sized such that the penetration per blow at the required ultimate capacity does not exceed 0.5 inches.
  - (3) A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by the Contractor if the pile installation stresses predicted by wave equation analysis or calculated by the Pile Driving Analyzer measurements exceed the following maximum values:

Pile Type	Compression Stress	Tension Stress
Steel	$0.9 F_y$	$0.9 F_y$
Prestressed Concrete	$0.85 f'_c - f_{pe}$	$3 f'_c + f_{pe}$
Precast Concrete	$0.85 f'_c$	$3 f'_c$
Timber	$3 \sigma_a$	$3 \sigma_a$

Notes:

$F_y$  = Steel Yield Strength in psi

$f'_c$  = Concrete Compressive Strength in psi

$f_{pe}$  = Effective Prestress After Losses in psi  
 $\sigma_a$  = Allowable Timber Design Stress in psi  
 Sample Timber Allowable Stresses,  $\sigma_a$ , in psi  
     1200 Douglas Fir  
     1100 Red Oak  
     1200 Southern Pine  
     800 Eastern Hemlock

(c) Load Test Pile Program.

- (1) Load test piles shall be driven to the minimum pile penetration depth or an ultimate capacity of 2.25 times the design load based upon the preliminary driving resistance indicated by wave equation results. Adjustments to the preliminary driving criteria may be made by the Chief Engineer based upon the dynamic testing results.
- (2) All load test piles shall be re-driven with dynamic testing after a minimum waiting period of one day. The pile(s) which is(are) statically load tested shall be re-struck with dynamic testing within 48 hours after completion of the static load test to obtain a correlation between static and dynamic test results for reference across the site. The re-strike driving sequence shall be performed with a warmed up hammer and shall consist of striking the piles for 20 blows or until the pile penetrates an additional three inches, whichever occurs first. In the event the pile movement is less than ¼ inch during the re-strike at satisfactory hammer energy output, the re-strike may be terminated after 20 blows.

(d) Production Pile Testing.

- (1) Dynamic pile testing may be performed on 5% of the production piles during restrrike driving over the duration of the production pile installation at the direction of the Chief Engineer.
- (2) The Chief Engineer may request additional piles to be dynamically tested if the hammer and/or driving system is replaced or modified, the pile type or installation procedures are modified, the pile capacity requirements are changed, unusual blow counts or penetrations are observed on any other piling behavior differ from normal installation.

(e) Dynamic Load Test Pile Program.

- (1) The Dynamic Testing Consultant shall prepare a written report of the load test pile program. This report shall contain a discussion of the pile capacity obtained from the dynamic and static testing. The report shall also discuss hammer and driving system performance, driving stress levels, and pile integrity.
- (2) The dynamic pile test data obtained from the end of initial driving and the beginning of re-strike of all the load test piles, shall be analyzed using an approved wave equation analyses program.

These analyses shall be performed by an engineer who has achieved Advanced Level or better on the Foundation QA Examination for Providers of PDA Testing Services. The Chief Engineer may request additional analyses at selected pile penetration depths.

- (3) For a blow count based driving criterion, the Dynamic Testing Consultant shall perform a refined wave equation analysis or analyses based upon the variations in the subsurface conditions and/or drive system performance observed in the load test pile program results. Refined wave equation analyses are not required for re-strike situations or when piles are driven to depth.
- (f) Dynamic Testing Reports.
- (1) Within one day of production pile testing, the Dynamic Testing Consultant shall prepare a hand written daily field report summarizing the dynamic testing results. As a minimum, the daily reports shall include the calculated driving stresses, transferred energy, and estimated pile capacity at the time of testing. Non-uniform piles require a wave equation analyses for capacity determination. Variations from previous trends in the dynamic test data shall also be noted. Daily field reports shall be transmitted to the Chief Engineer.
  - (2) Once per month, or upon completion of various project or testing phases, the Dynamic Testing Consultant shall prepare a formal report summarizing the dynamic testing results. This report shall be submitted no later than ten working days after the completion of the reported part of the testing.

#### 701.06 STEEL H PILES

- (A) **SPLICES.** The Contractor may, at his option, splice pieces of steel H- piles to secure the lengths required; however, only one splice per pile will be permitted. Splices shall be as shown on the plans or as approved by the Chief Engineer. Pile lengths shorter than 5 feet will not be permitted. Insofar as practicable, the splice will be located so that its final position will be in firm material underlying the foundation. All splice material shall conform to 815.01(A) or (B). Splicing in the leads will not be permitted unless approved by the Chief Engineer. All welding shall be done by the electric-arc process and shall conform to the specifications of AASHTO/AWS D1.5 as modified by AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges.
- (B) **SPLICE WELDS.** All temporary and permanent pile splice welds shall be made only by welders qualified in accordance with 706.18(C). No jet welding will be permitted without prior written approval from the Chief Engineer.

#### 701.07 CAST-IN-PLACE CONCRETE PILES (STEEL CASING)

- (A) **INSPECTION OF METAL SHELLS.** At all times prior to the placing of concrete in the driven shells, the Contractor shall have available a suitable light for the inspection of each shell throughout its entire length. Any improperly driven, broken or otherwise

defective shell shall be corrected to the satisfaction of the Chief Engineer, by removal and replacement, or the driving of an additional pile, at the sole expense of the Contractor.

- (B) **SPLICING.** Splicing of steel shells shall be in accordance with the manufacturer's recommendations.
- (C) **REINFORCEMENT.** Unless otherwise shown on the plans, Cast-In-Place Piles shall have reinforcement extending 20 feet into the pile measured from the cutoff elevation.
- (D) **DRIVING.** For special types of piling, pile-driving heads or caps, mandrels, or other device, in accordance with the manufacturer's recommendation for the particular type of pile specified, shall be provided to protect the pile head against damage during pile driving and hold the axis of the pile in line with the axis of the hammer.
- (E) **PLACING CONCRETE.** All pile shells in a footing shall preferably be fully driven before any are filled with concrete, but in no event shall concrete be placed in a shell, until all driving within a radius of 15 feet has been completed. Shells shall be cut off at the required elevation and shall be free of water when concrete is placed.

#### **701.08 PRECAST REINFORCED CONCRETE PILES**

- (A) **FORM WORK.** Forms for precast concrete piles shall conform to the general requirements for concrete formwork as specified under 703.
- (B) **REINFORCEMENT.** Reinforcement shall be placed in accordance with details shown on the plans, and as outlined in 704.
- (C) **CASTINGS.** The piles shall be cast in a horizontal position on a suitable platform meeting the approval of the Chief Engineer. Concrete shall be placed according to the applicable provisions of 703. The forms shall be overfilled, the surplus concrete screened off, and the top surface finished to a uniform, even texture similar to that produced by the forms. Each pile shall be marked with its casting date. If required, portions of the piling exposed to view shall be finished as provided in 703.19.
- (D) **CURING.** Curing shall be performed as outlined in 703.18 except that the period of curing will be 14 days in lieu of 7 as specified. No piles shall be moved from their casting positions in less than 7 days nor be driven within 21 days after casting.
- (E) **STORAGE AND HANDLING.** Removal of forms, curing, storing, transporting and handling precast concrete piles shall be done in such a manner as to avoid excessive bending stresses, cracking, spalling or other injurious results. Supports for handling cured piles shall not be more than 20 feet apart and computed stress in reinforcement shall not exceed 12,000 pounds per square inch, based on the calculated weight of the pile plus 100 percent of the same weight for impact and shock. During storage, piles shall be firmly supported at points not more than 4 feet apart throughout their length and shall be separated from each other at least 4 inches. When piles are stored in tiers, supports shall be placed directly over the supports for the lower piles. No tier shall contain more than 4 piles.
- (F) **CAPS.** When the nature of the driving is such as to unduly injure the heads of the piles, they shall be protected by caps of approved design.

Care shall be taken to insure full bearing of the driving cap on the pile for proper and uniform distribution of the hammer blow.

- (G) **SPLICES.** Extensions or splices shall be avoided wherever possible.

If required, the following procedures shall be met:

The concrete at the end of the pile shall be cut away, leaving the reinforcement exposed for a length of 30 diameters of the bars. The cut shall be perpendicular to the axis of the pile. Reinforcement similar to that used in the pile shall be lapped 30 diameters and fastened to the projecting steel. In placing the formwork for the extension, care shall be taken to avoid leakage along the pile. Prior to placing the concrete, the top of the pile shall be thoroughly wetted and covered with a thin coating of 1:2 cement mortar.

#### 701.09 PRECAST PRESTRESSED CONCRETE PILES

- (A) **CONCRETE.** Precast prestressed concrete piles shall not be driven until the concrete has attained a compressive strength of not less than 5000 pounds per square inch, but in no case less than three days from the date of pouring.
- (B) **PROTECTION.** Heads of the piles shall be protected in accordance with 701.08(F).
- (C) **PRESTRESSING STRANDS.** The prestressing strand shall have a minimum breaking strength for 7/16 inch strand of 31,000 pounds and a minimum load at one percent extension of 26,350 pounds with an initial load of 3100 pounds. The prestressing load applied to the strand shall be 21,700 pounds. Each reel of strand and all samples furnished to the Chief Engineer for testing shall bear a tag identifying the strand as extra high strength.
- (D) **PILE ENDS.** Each end of the piles shall have extra reinforcement as shown on the plans. All prestressing strands shall be ground flush with each end of the pile.
- (E) **FABRICATION TOLERANCE.** The piles shall be constructed to a tolerance of -0 to +12 inch of the cross sectional dimensions shown on the plans. The tolerance from a straight line along the longitudinal axis shall be the same as specified for precast concrete piles.
- (F) **SPLICES.** Extensions or splices of pre-cast prestressed concrete piles shall be avoided whenever possible. However, if these splices are required the following procedure shall be employed. After driving is completed, the concrete at the end of the pile shall be cut away, leaving the prestressing strand exposed for a minimum length of 24 inches for precast, prestressed concrete piles. Reinforcement as shown on the plans shall be lapped a minimum of 24 inches with the projecting prestressing strands. In placement of formwork for the exterior, care shall be taken to avoid leakage along the pile. Prior to placing the concrete, the top of the pile shall be thoroughly wetted and covered with a thin coating of 1:2 cement mortar.

#### 701.10 TIMBER PILES

- (A) **SPLITTING.** Metal collars, bands, or other approved devices to protect the piles against splitting or brooming shall be provided where necessary.

- (B) **PILE POINTS.** Piles shall be pointed where soil conditions require it. When necessary, the piles shall be shod with metal shoes of a design satisfactory to the Chief Engineer, the points of the piles being carefully shaped to secure an even and uniform bearing on the shoes.
- (C) **SPLICES.** Full-length piles shall always be used where practicable but, if splices cannot be avoided, an approved method of splicing shall be used. Piles shall not be spliced except by written permission of the Chief Engineer.
- (D) **LENGTH.** The lengths of piles shall include ample allowance for fresh heading and for such depth as may be necessary to suit the Contractor's method of operation.
- (E) **SURFACE PROTECTION.** In the event that treated timber piles are specified, special care shall be taken to avoid breaking the surface. Cuts or breaks in the treated surface shall be repair as per the recommendations of the pile supplier.
- (F) **PROTECTION.** The heads of piles shall be protected by caps of approved design.

#### 701.11 MEASURE

- (A) **PILING.** The unit of measure for Timber, Precast Concrete, Cast-In-Place Concrete with Steel Casting, Steel H, Prestressed or Test Piles will be the linear foot.

The number of feet measured will be the actual number of linear feet left in the completed structure of piles acceptably driven, as measured along the axis of the pile from the tip of the pile to the cutoff elevation shown on the plans. No measurement will be made of cutoffs, broken piles or piles driven out of position.

#### (B) LOAD TESTS.

- (1) **STANDARD LOAD TESTS.** The unit of measure for Standard Load Tests will be each. The number will be the actual number of standard tests performed.
- (2) **QUICK LOAD TESTS.** The unit of measure for Quick Load Tests will be each. The number will be the actual number of quick load tests performed.
- (3) **HIGH-STRAIN DYNAMIC TEST.** The unit of measure for High-Strain Dynamic Load Test will be each. The number will be the actual number of dynamic tests performed.

#### 701.12 PAYMENT

- (A) **PILING.** The number of linear feet of piling, as measured in 701.11(A), will be paid for at the contract unit price per linear foot for:
  1. Untreated Timber Piles
  2. Treated Timber Piles
  3. Steel H Piles
  4. Precast Concrete Piles
  5. Cast-In-Place Concrete Piles
  6. Pre-stressed Piles

7. Length Test Piles of the type and size specified, which payment will include all labor, materials, tools, equipment and incidentals necessary to furnish and drive the piles completely in place.

Load test piles, whether or not they become permanent piles, will be paid at the contract price for regular piles of the type and size specified.

Payment for H Piles includes temporary and permanent pile splices and welding.

- (B) LOAD TESTS.** The number of load tests, as measured in 701.11(B), will be paid for at the contract unit price per each, which payment will include furnishing and removing all testing materials, loading and unloading the piles, guide platforms and all other material, labor, equipment and incidentals necessary to complete the item as specified herein. Pile Load Test will not include cost of pile tested. Payment does include driving and removal of reaction and anchor piles, reaction and anchor piles left in place but not considered as permanent piles, backfilling holes left from pulled piles, jacking equipment and associated equipment necessary to complete each load test.

## **702 SUBFOUNDATION WORK MAT CONCRETE**

### **702.01 DESCRIPTION**

Subfoundation work mat concrete shall be used in areas as approved and directed by the Chief Engineer or as shown in the contract documents. It is intended to be used as a work mat for spread and pile foundations. Subfoundation work mat concrete shall consist of the removal and disposal of foundation material immediately below the footing plan grade and replacement with concrete as herein specified.

The Contractor will be required to furnish his own disposal area for removed material.

### **702.02 MATERIALS**

Materials shall conform to the requirements of 817.02. Work mat concrete shall contain 4 bags of portland cement, 1,336 lbs. of sand (+ or -10), 1,844 lbs. (+ or -10) #67 gravel, and 41 gallons of water per cubic yard.

### **702.03 CONSTRUCTION REQUIREMENTS**

Concrete masonry construction shall conform to pertinent requirements of 703. The slump shall not exceed 6 inches. The depth of the subfoundation work mat concrete below the footing plan grade shall be as shown in the contract documents. Concrete need not be vibrated but shall be puddled, spaded, and worked in a sufficient extent to insure elimination of voids. No surface finishing of the concrete is required. However, within footing areas, the surface shall be rough, reasonably level and uniform, and no higher than the plan elevation of bottom of the footing. Provisions applying to sheeting, shoring and bracing shall be as required in 205.

### **702.04 MEASURE AND PAYMENT**

The unit of measure for Subfoundation Work Mat Concrete will be the cubic yard. The number of cubic yards will be the actual amount of subfoundation work mat concrete used but limited to the net footing plan dimensions and a thickness as shown in the contract documents. No measurement will be made for subfoundation work mat concrete in excess of the thickness specified in the contract documents.

The number of cubic yards of Subfoundation Work Mat Concrete determined above will be paid for at the contract unit price per cubic yard which payment will include all labor, materials, equipment, tools, and incidentals necessary to remove and dispose of subgrade material and replace it with Subfoundation Work Mat Concrete, as herein specified.

## 703 CONCRETE FOR STRUCTURES

### 703.01 DESCRIPTION

Concrete for structures shall consist of portland cement concrete used in structures constructed in conformity with the lines, grades and dimensions as shown on the plans or as specified by the Chief Engineer. This item shall also include, where applicable, furnishing and installing emblems and reference marks, setting of all necessary anchor bolts, and installing manhole frames and covers.

### 703.02 MATERIALS

- PCC Concrete Mixtures – 817, Class A or B
- Curing materials – 814.01, 814.02(A), 814.02(C), 814.03
- Preformed joint filler – 807.01(B)
- Waterstop – 807.05
- Epoxy – 822.08
- Epoxy mortar – 806.05(C)

### 703.03 PROPORTIONING

#### (A) GENERAL

Aggregates and portland cement shall be proportioned by weight. Water may be proportioned by volume or by weight. Batch weights of aggregates for the concrete shall be corrected for free moisture, as calculated from moisture determinations performed by the Contractor as directed by the Chief Engineer. These moisture determinations shall be made as frequently as deemed necessary by the Chief Engineer.

#### (B) ADJUSTMENTS

The Contractor shall submit a mix design conforming to 817.01 for the approval of the Chief Engineer. The approved mix design shall not be changed except as provided below.

1. Adjustment for variation in fineness modulus (FM). If the FM of the fine aggregate varies by more than 0.20 from the established value, the mix design shall be adjusted as provided in 817.01.
2. Adjustment for variation in workability. If it is impossible to obtain PCC of the desired workability with proportions approved by the Chief Engineer, the Contractor shall make such changes in aggregate weights as necessary, provided that in no case shall the cement content originally designated be changed except as provided below.
3. Adjustment for variation in consistency. If it is found impossible to produce concrete having the required consistency without exceeding the maximum allowable water-cement ratio specified, the cement content may be increased as approved by the Chief Engineer so that the maximum allowable water-cement ratio will not be exceeded.
4. Adjustment for variation in yield. If cement content of the PCC determined by AASHTO T 121 varies more than plus or minus 2 percent from the approved design

mix, the proportions shall be adjusted by the Contractor and approved by the Chief Engineer to maintain a cement content within these limits. The water content shall not exceed the maximum approved.

5. Adjustment for new materials. Change in source or character of the materials shall be made only after tests on trial mixes and with the Chief Engineer's written approval.

Suitable means shall be provided for accurately determining the amount of moisture in the aggregates.

#### **703.04 HANDLING, MEASURING AND BATCHING MATERIALS**

##### **(A) GENERAL**

The supplier of the concrete shall have sufficient plant capacity and transportation apparatus to provide delivery at the rate required to insure that the depositing of the concrete will be continuous.

Unless otherwise permitted by the contract, batching plants shall be equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocked proportioning devices of approved type.

Methods and equipment for adding air-entraining agent or other admixtures to the batch, when required, shall be approved by the Chief Engineer. All admixtures shall be measured into the mixes within a tolerance of plus or minus 3 percent.

Batch plant equipment shall meet the requirements of 905.01.

- (B) STOCKPILES:** Stockpiles shall be built up in layers of not more than 3 feet in thickness. Each layer shall be completely in place before beginning the next, which shall not be allowed to come down over the next lower layer. Aggregates from different sources and of different gradings shall not be stockpiled together.

Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to minimize segregation of the material. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain high or non-uniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the Chief Engineer.

- (C) HANDLING FINE AGGREGATE:** The fine aggregate and each size of coarse aggregate shall be separately weighed into hoppers in the respective amounts conforming to the approved mix design. Cement shall be measured by weight. Separate scales and hoppers shall be used for weighing the cement with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. Batching shall be so conducted as to result in weights of each material required within tolerances of plus 4 percent for cement, +/- 2 percent for aggregates, and +/- 1 percent for water. The accuracy of measuring the water shall be within a range of error of not over 1 percent.

**703.05 MIXING CONCRETE**

- (A) **GENERAL.** The concrete may be mixed wholly or in part in paving mixers, stationary mixers or truck mixers located at a central plant or at the site. Ready-mixed concrete shall conform to the requirements of AASHTO M 157. Concrete mixed under these specifications shall be of uniform consistency and such that the mortar will bond to the coarse aggregate. It shall not be sufficiently wet to flow readily or segregate, nor shall it be of a mealy or too dry consistency.

The interval between batches shall be such that the concrete in place does not partially harden and in no case shall this interval exceed 30 minutes. The time interval between admission of cement to the aggregate and final discharge of the concrete shall not exceed one and one-half hours. The time interval shall not exceed one hour for hot weather (85°F or above) construction. Concrete which has developed an initial set shall not be used. Retempering of partially set concrete by mixing with additional water is prohibited.

Delivery of concrete materials shall be controlled by tickets issued to the driver at the plant. These tickets shall contain information as directed by the Chief Engineer. Upon arrival at the job site, the tickets shall be given to the Chief Engineer.

Concrete mixing and delivery equipment shall meet the requirements of 905.02

- (B) **TRUCK MIXING.** All wash water shall be dumped before reloading the truck with concrete or concrete materials. No truck shall be loaded which contains free water in the drum. In depositing aggregates into the mixer drum, and in fastening the charging gate, no free water in excess of that found in the moisture determinations shall be admitted into the mixer drum.

Mixing water and wash water for truck mixed PCC shall be stored in watertight tanks, separate from the mixing drum. Each tank shall be equipped with an approved, operable, calibrated gauge. Water tanks shall be completely filled at the plant. If, on arrival at the job, inspection reveals a drop in the water level, the batch may be rejected. All mixing water, other than free moisture in the aggregates, shall be added to the mix in the presence of the Chief Engineer. Prior to adding mixing water to the drum the mixing water gauge valve shall be set to show the water level in the tank, and the gauge shall be read and recorded in the presence of the Chief Engineer. No wash water shall be used until all concrete in the drum has been discharged.

The Contractor shall provide a level area for all truck mixing.

After all materials, including water, have been added to the mixing drum, mixing shall be in accordance with latest recommendations of the mixer manufacturer for a minimum of 70 and a maximum of 100 revolutions excluding revolutions at the agitation speed. The mixing speed shall not be less than 4 rpm and not more than 18 rpm.

If the slump is less than that desired, additional water may be added if permitted by the Chief Engineer. After addition of the water, the mixing drum shall be rotated 20 to 30 revolutions at the mixing speed before the discharge of the concrete. After the addition of water the number of revolutions shall not exceed 100, except for concrete mixes containing coarse aggregates which do not wear more than 25 as determined in

accordance with Resistance to Abrasion of Small Size Coarse Aggregate, AASHTO T-96, for which the number of revolutions shall not exceed 130.

The rate of discharge of concrete from the mixer drum shall be controlled by the speed of rotation in the discharge direction with the discharge gate fully open.

- (C) **TRANSIT MIXING.** Transit mixing shall be in accordance with 703.05(B) except:

Mixing water shall be accurately measured at the proportioning plant and added to the mixing drum at the plant. Mixing may be done at the plant or at the job site, at the option of the Contractor. In either case, the mixer drum shall be rotated at the agitation speed from the time the truck leaves the plant until it arrives at the job site.

- (D) **CENTRAL MIXING.** When central mixing is used, the proportioning and mixing plant shall meet all the requirements governing the handling, proportioning and mixing of concrete materials in a stationary mixer in conformance with AASHTO M 157.

The mixed concrete shall be conveyed from the central mixing plant to the site of the work in agitator or non-agitator trucks conforming to 905.02. The time elapsing from the time cement is added to the mix until the concrete is deposited in place at the site of work shall not exceed 45 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when hauled in truck mixers or truck agitators, except that in hot weather (85°F or above) the time interval shall not exceed one hour.

- (E) **PAVING MIXERS.** Paving mixers having a rated capacity of 27 cubic feet or over may be used when approved by the Chief Engineer.
- (F) **HAND MIXING.** Hand mixed batches of concrete may be allowed only in an emergency. The total quantity of such batches shall not exceed 1/2 cubic yard. Hand mixing shall be subject to the immediate direction and approval of the Chief Engineer.

### 703.06 TESTING AND ACCEPTANCE

- (A) **CONSISTENCY.** The consistency of the concrete will be checked by the slump test in conformance with AASHTO T 119. Maximum slump shall be as specified in 817.03(B). The determination will be made when and as often as deemed necessary by the Chief Engineer to check the consistency of the concrete. The Contractor shall provide a slump cone, rod and a flat, non-absorbent surface in conformance with AASHTO T 119, for each project.
- (B) **AIR CONTENT.** Air content of plastic concrete shall be tested in conformance with AASHTO T 196 or AASHTO T 152 as determined by the Chief Engineer. The entrained air shall be as specified in 817.03(B). The Contractor shall furnish and maintain two (2) air meters in conformance with AASHTO T-152 Type B and one (1) meter meeting the requirements of AASHTO T-196. The air meters shall be calibrated by an independent laboratory, a certification of which shall be provided to the Chief Engineer.
- (C) **COMPRESSIVE STRENGTH.** Test cylinders will be made from each class of concrete, at the direction of the Chief Engineer. Concrete for such specimens shall be furnished by the Contractor as directed. One set of concrete test specimens shall be made for every fifty (50) cubic yards or less of concrete placed.

Concrete test specimens for compression strength testing shall be made and cured in accordance with AASHTO T 23. Compressive strength shall be tested in conformance with AASHTO T 22. Unless otherwise specified, the minimum 28 day compressive strength shall be in accordance with 817.03(B). The Contractor shall provide cylinder-curing facilities at the project site in conformance with AASHTO T 23. Immediately after molding and finishing, the concrete specimens shall be stored up to 48 hours in concrete curing box with pre-set temperature controls and in an environment to prevent moisture loss from the specimens. The cylinders should be placed in a thermostatically climate controlled storage chest with adjustable temperature controller for heating or cooling and the temperature shall be maintained between 60° F and 80° F. Listed below are two pre-approved concrete curing boxes:

Forney Model No. LA-1302

Humboldt Model No. H-2968

Curing boxes other than these listed must be submitted to and approved by the Chief Engineer prior to use.

The Contractor shall transport the PCC specimens to DDOT testing facility in conformance with AASHTO T23 (Transportation of Specimens to Laboratory). The Contractor shall furnish the Engineer with two (2) concrete thermometers meeting the requirements of AASHTO T 309.

- (D) PUMPED CONCRETE.** When concrete is pumped, concrete will be sampled for conformance to the consistency requirements before pumping and before the addition of approved admixtures, which are added at the site after initial mixing. Concrete will be sampled for air content before pumping. However, the air content will be adjusted to compensate for changes in the air content which occur during pumping as determined by the Chief Engineer.

Approved High Range Water Reducer (HRWR) may be added. After the addition of HRWR, the slump and percentage of air shall be measured at the point of delivery. The following criteria shall apply:

Class A Structural Concrete – Maximum slump: Five (5) inches

Class H1 and Class H2 Structural Lightweight Concrete – Maximum slump: Five (5) inches

Class B Structural Concrete – Maximum slump: Six (6) inches

Percentage of Air by Volume: Six (6) to Eight (8) percent

Unit weight shall be measured. All PCC specimens shall be obtained from the end of the pump discharge.

- (E) ACCEPTANCE.** Concrete acceptance shall meet the requirements of 817.03.

If the 28-day compressive strength of the concrete cylinders falls below the specified strength as per District of Columbia Standard Specifications for Highways and Structures,

Table 817.03, a price reduction shall be made for the quantity of concrete represented by the non-conforming cylinders determined from the following:

Percent of Minimum Specified Strength (%MSS)	Percent Price Reduction of Contract Unit Price
%MSS ≥ 98	0
95 ≤ %MSS < 98	10
90 ≤ %MSS < 95	20
%MSS < 90	Reject

1. When compressive strength test results of cylinders from concrete does not obtain at least 90% of the minimum design strength in 28 days, the concrete will be in reject and cores shall be obtained for testing to evaluate the strength of concrete in place. Consideration for acceptance may be based on cores removed from the in-place concrete. Obtaining and testing cores of concrete shall be entirely at the Contractor's expense.
2. Cores shall be obtained by an independent firm, accredited by AASHTO, in the presence of a District Department of Transportation representative and the Contractor. The sample location, number, and size of cores will be determined by the Engineer.
3. Cores shall be tested by the District Department of Transportation or an independent testing firm accredited by AASHTO in testing concrete.
4. All conditioning and testing shall be in accordance with AASHTO T 24. The testing laboratory shall provide a written report on the results to the District Department of Transportation and the Contractor. The test report shall be signed and sealed by a Professional Engineer.
5. Replacement of deficient concrete shall be entirely at the Contractor's expense.

**703.07 WEATHER RESTRICTIONS AND NIGHT WORK**

- (A) **HOT WEATHER CONSTRUCTION.** The maximum temperature of concrete for bridge decks, approach slabs and other structural slabs shall be 80°F. The maximum temperature of concrete used for other structures shall be 90°F. If the required consistency cannot be maintained, the mix shall be adjusted in accordance with 703.03. The temperature of the cement at the time of batching shall not exceed 160°F. All deck reinforcing steel that comes in contact with the plastic concrete shall be cooled to below 90°F before concrete placement.
- (B) **COLD WEATHER CONSTRUCTION.** When the forecast of the National Weather Service indicates that the temperature is expected to be less than 50°F during the 24 hour period following the placing of the concrete, a Type C accelerator meeting the requirements of 814.05(A) shall be incorporated in the concrete mix at the batching plant.

No concrete shall be placed without permission of the Chief Engineer when the ambient temperature reaches 40°F and is descending or when the U.S. Weather Bureau forecasts that the temperature will drop below 40°F during the 24 hour period following the placing of the concrete. If the Chief Engineer permits concrete placement at temperatures lower than those specified above, the following requirements shall be met:

1. The temperature of the mixed concrete shall not be lower than 50°F and not more than 90°F at the time of placement.
2. When directed by the Chief Engineer, the Contractor shall enclose and heat the structure in such a way that the concrete and air within the enclosure is kept above 55°F for a period of 7 days after placing concrete. When dry heat is used, means of maintaining atmospheric moisture shall be provided.

In lieu of enclosing and heating the structure, approved form insulation may be used for concrete other than deck slabs. Form insulation shall be completely enclosed in a waterproof material which shall be maintained in a good and serviceable condition at all times. The blanket shall be applied tightly against the forms in an approved manner so as to exclude air and moisture. Both horizontal and vertical surfaces shall be covered and care shall be taken to see that all edges and corners are properly covered. If necessary, the tops of placements shall be protected by a tarpaulin or other waterproof cover over the insulation. The insulation shall be capable of maintaining the temperature of the concrete in the forms between 55°F and 100°F for a period of at least 7 days. At the end of the protection period the temperature of the concrete within the forms shall be gradually decreased at a rate of cooling not to exceed 20°F per 24 hours by gradually loosening the forms or insulation.

3. No concrete shall be placed on frozen grade nor shall frozen aggregates be used in the concrete.

No direct payment will be made for incorporating an accelerator in the concrete or for the insulated curing required for cold weather construction. The cost of this work will be included in the contract price for the various portland cement concrete pay items.

The Contractor will be held responsible for any defective work caused by freezing. Concrete damaged in any manner shall be removed and replaced without cost to the District of Columbia.

- (C) **WIND.** No deck concrete placement shall be scheduled or started when it is anticipated that the wind velocity, excluding gusts, will exceed 15 M.P.H. as forecast by the National Weather Service.
- (D) **NIGHT WORK.** Concrete for bridge decks, approach slabs and other structural slabs shall be placed at night from June 1 through September 15. During this period concrete placement operations shall be scheduled so that no concrete shall be placed before 9:00 PM and all concrete shall be deposited within the forms before 7:30 AM. Regardless of the date, no concrete placement shall be scheduled when it is anticipated that the temperature at an un-shaded location within the placement site will exceed 80°F.

No other concrete shall be placed during night hours unless specified in the contract or permitted by the Chief Engineer.

An adequate lighting system shall be provided during nighttime construction for both placement operations and inspection testing. A minimum of 20 foot-candles illumination at the slab elevation shall be provided at all areas within the placement site. A suitable light meter shall be provided to measure the illumination. A lighting plan shall be submitted to the Chief Engineer for approval. In addition, before any initial slab placement operation, a test run shall be made to insure that the specified illumination is provided. If a portable generator is used, an emergency backup generator shall be available at the job site.

### 703.08 PLACING CONCRETE

- (A) **GENERAL.** The Contractor shall ascertain that a sufficient supply of concrete to completely fill the forms without interruption will be available before starting the placement of concrete. The concrete delivery and placement rate shall be approved by the Chief Engineer and shall be such that no previously placed batch is allowed to partially harden before the placement of the subsequent, adjacent batch.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization of the Chief Engineer. In case an inferior quality of concrete is produced by the use of such conveyors, the Chief Engineer may order discontinuance of their use and the substitution of a satisfactory method of placing.

- (B) **FORMS.** Struts, stays, and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete. After the initial set of the concrete, the forms shall not be jarred, and no strain shall be placed on the ends of reinforcing bars which project.

No concrete shall be placed until the depth and character of the foundation, the adequacy of the forms and falsework, and the placing of reinforcing steel have been inspected and approved by the Chief Engineer. Such approval shall not relieve the Contractor from responsibility for satisfactory performance of his work.

- (C) **DELIVERY TO FORMS.** Open troughs and chutes shall be of metal or metal lined. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement.

All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discharged clear of the structure.

When placing operations would involve dropping the concrete more than 5 feet, it shall be deposited through sheet metal or other approved pipes. Pipes shall be so constructed so that concrete is not allowed to free-fall more than 5 feet. Pipes will not be required for walls 2 feet thick and under.

In preparation for the placing of concrete, all sawdust, chips, and other construction debris and extraneous matter shall be removed from the interior of the forms.

Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

Special care shall be taken to fill each part of the forms by depositing the concrete as near the final position as possible. Working or flowing of concrete along the forms from the point of deposit will not be permitted.

- (D) **SPREADING MACHINES.** When approved for use by the Chief Engineer spreading machines shall meet the requirements of 905.05.
- (E) **EMERGENCY SHUTDOWN.** In case of emergency shutdown, steps shall be taken, as required by the Chief Engineer, to prevent detrimental effects on placing operations. For bridge deck concrete, the Contractor shall provide a suitable construction joint by use of a bulkhead to the satisfaction of the Chief Engineer. Excess concrete shall be removed from the forms and disposed of properly.
- (F) **CLEANUP.** Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon the reinforcing steel, anchor bolts and the surface of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to break the concrete-steel bond at and near the surface of the concrete while cleaning the reinforcing steel.

#### 703.09 CONSOLIDATION

- (A) **GENERAL.** Concrete, during and immediately after depositing, shall be thoroughly consolidated. Consolidation shall be done by mechanical vibration subject to the following provisions.

Each layer shall be placed and consolidated before the preceding layer has taken initial set to prevent the formation of a cold joint between layers.

- (B) **EQUIPMENT.** The vibration shall be internal unless special authorization of other methods is given by the Chief Engineer, or as provided herein.

Vibrators shall be of a type and design approved by the Chief Engineer and shall meet the requirements of 905.07. The intensity of vibration shall be such as to visibly affect a mass of concrete of one (1) inch slump over a radius of at least 18 inches.

The Contractor shall provide a sufficient number of vibrators to properly consolidate each batch immediately after it is placed in the forms. The size of the vibrator shall be governed by the space available for its use in the forms and between reinforcing bars.

Hand tools shall meet the requirements of 905.09.

- (C) **APPLICATION OF VIBRATIONS.** Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective, or not more than 3

feet apart throughout the mass of concrete. Vibrations shall be transmitted directly to the concrete and in no case shall they be transmitted through the forms.

Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms.

Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and imbedded fixtures and into corners and angles of the forms.

Vibration shall be supplemented by such spading as is necessary to insure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

### **703.10 PLACING CONCRETE BEHIND STONE MASONRY**

No concrete shall be placed back of stone masonry for the first 24 hours after the stone has been set and until the mortar in the masonry has set sufficiently to withstand the pressure of fresh concrete. The concrete shall be placed in such a manner as to avoid damaging pressures on the stone masonry.

Anchorage and bracing shall be outlined in 708.09 and 708.10(F). The requirements for bonding concrete to stone masonry shall be outlined in 708.10(E).

### **703.11 DEPOSITING CONCRETE UNDERWATER**

- (A) **GENERAL.** Concrete shall not be exposed to the action of water before setting and shall not be deposited underwater except with the approval of the Chief Engineer and under his immediate supervision, and, under his conditions, the method of placing shall be as designated herein.

Concrete deposited underwater shall be tremie concrete. Tremie concrete shall be carefully placed in a compact mass in its final position by means of tremie pipes in such manner as to produce a continuous, complete monolith of concrete without joints, of the full area of the foundation and of the thickness required, and concrete shall not be disturbed after being deposited. Concrete shall be deposited only under still water and in forms or cofferdams which are substantially watertight.

The cement content of concrete to be placed underwater shall be increased by 10 percent over that of comparable concrete placed above water.

Placement of underwater concrete by means of bottom dump buckets will not be permitted.

- (B) **PLACEMENT.** Concrete deposited as seal courses of foundation bases shall be placed in continuous operations without any cessation, and if necessary, both day and night without midday or other stops until the entire mass of the seal has been placed. Adequate plant and supplies of material shall be on hand to assure such continuous operation. The concrete plant shall be so arranged that breakdown of any piece of equipment will not necessitate complete shutdown. Depositing shall be so distributed in the area of placement that the surface of the concrete shall be kept as horizontal as practicable at all times.

- (C) **TREMIES.** Tremies shall consist of watertight tubes, preferably of steel pipe about 10 inches in diameter constructed in sections having screwed joints of flanged couplings fitted with gaskets, and fitted at the top end with a hopper. Tremie tubes shall be sufficiently long so that when set on the bottom of the excavation where concrete is to be deposited the hopper shall extend above the water. Tremies shall be supported so as to permit proper filling of the hoppers and so that the tremie can be raised vertically with a slow movement and lowered rapidly to retard the flow of concrete. The discharge end of each tremie tube shall, unless otherwise permitted by the Chief Engineer, be equipped with an approved automatic check valve. At the start of the work, the check valve shall be closed to prevent water from entering the tube and thereafter the discharge end shall be entirely sealed at all times by being set upon the bottom of the excavation or upon concrete already deposited and the tremie tube shall be kept full to the bottom of the hopper. When a batch of concrete is dumped into the hopper, the tremie shall be slowly raised but not out of the concrete at the bottom of the tremie and until the batch discharges to the bottom of the hopper; the tremie shall then be quickly lowered and the flow of concrete stopped.

A sufficient number of tremies shall be provided for each foundation so that the lateral flow from any tremie shall not exceed 10 feet unless otherwise approved by the Chief Engineer. The sequence of depositing concrete in tremie pipes shall be as directed by the Chief Engineer. The interval between depositing one batch of concrete in a given tremie and depositing the next batch therein in no case shall exceed 15 minutes and preferably shall be more rapid.

- (D) **FINISHING.** After concrete is placed and succeeding courses have properly hardened, the water shall be pumped out and any laitence which may have accumulated on the concrete or any defective concrete which is exposed shall be removed and the surface suitably prepared for additional concrete.

The Contractor's attention is directed to the fact that the elevation of the completed surface on the top of the seal must be such that the required elevations noted in the contract documents for the substructure can be maintained. When necessary to maintain this elevation, the Contractor shall be required to chip away the concrete, and any costs incidental thereto will be at the sole expense of the Contractor.

### 703.12 PUMPING CONCRETE

Placement of concrete by pumping will be permitted only if authorized by the Chief Engineer. The equipment shall be so arranged that no vibrations result which might damage freshly placed concrete. When concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipe line, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. Aluminum pipes shall not be permitted for placing concrete.

The slump of concrete to be pumped shall not be increased by the addition of water such that the slump exceeds the maximum limits of 817. In no case shall the maximum water-cement ratio be exceeded as allowed in the approved mix design. If approved by the mix design, the slump may be increased by the use of admixtures.

### 703.13 CONSTRUCTION JOINTS

Construction joints shall be made only where indicated on the plans, unless otherwise approved by the Chief Engineer. If not detailed on the plans, or in case of emergency, construction joints shall be placed as directed by the Chief Engineer. Shear keys or inclined reinforcement shall be used, where directed, to transmit shear or to bond the two sections together.

Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened as required by the Chief Engineer in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance, and saturated with water. To insure an excess of mortar at the juncture of the hardened concrete and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly covered with a coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained the initial set.

The placing of concrete shall be carried continuously from joint to joint. Whenever the Chief Engineer so directs, the Contractor shall be required to place chamfer strips for vertical or horizontal construction joints so that the joint in the finished concrete will show as a V-notch. Such demarcation of construction joints shall be that produced by using 3/4 inch chamfer strips. All chamfer strips shall be milled lumber. Where construction joints are not notched as described above, the top surface of the concrete adjacent to the forms shall be smoothed with a trowel to avoid irregularity in the joint on exposed faces.

Where a "featheredge" might be produced at a construction joint, as in the sloped top surface of a wall, an insert formwork shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Work shall not be discontinued within 18 inches of the top of any face.

### 703.14 WOOD CONCRETE FORMS

(A) **GENERAL.** Concrete form drawings and calculations shall be prepared by or under the direction of a Registered Professional Chief Engineer and shall bear his P.E. seal. Forms shall be designed in accordance with the criteria specified herein.

(B) **FORM DESIGN.**

- (1) **GENERAL.** All lumber shall be stress-graded and the grade shall be stamped or branded on the lumber. The supplier shall submit certifications for the grades of lumber supplied. Working stresses used in form design shall not exceed allowable stresses for the grade of lumber furnished.
- (2) **LOADS.** Loads for design shall be in accordance with paragraph 2.2 of the American Concrete Institute Standard Recommended Practice for Concrete Formwork (ACI 347R).
- (3) **UNIT STRESSES.** Unit stresses for lumber shall be in accordance with the National Forest Products Association Publication titled "Design Values for Wood Construction."

(4) **DEFLECTION.** Maximum deflections for each form member shall not exceed the following:

- Exposed walls, abutments, piers, parapets and curb      L/360
- Unexposed (stone-veneered) walls, etc.                      L/270
- Decks and footings    L/180

(5) **GENERAL DESIGN INFORMATION.** Investigation of the strength and stiffness requirements of lumber components shall be made in accordance with the National Forest Products Association National Design Specifications and its manual titled “Wood Structural Design Data.” Adjustment of working stresses shall be made in accordance with the NDS.

Plywood thickness and joist or stud spacing shall be in accordance with Table 703.14. Metal ties, hangers and other hardware shall be designed in accordance with the manufacturer’s recommendations.

**TABLE 703.14 MAXIMUM STUD OR JOIST SPACING (INCHES)**

Form Pressure (psi)	Plywood Thickness					
	5/8-inch			3/4-inch		
	Allowable Deflection		Allowable Deflection	Allowable Deflection		
	L/360	L/270	L/180	L/360	L/270	L/180
100 and less	22	24	26	24	28	32
200	18	20	22	20	232	26
300	16	17	18	18	20	22
400	14	15	16	16	18	19
500	13	14	15	15	16	17
600	12	13	14	14	15	16
700	11	13	14	13	15	15
800	11	12	13	13	14	14
900	10	11	12	12	13	13
1000	9	11	11	12	12	12
1100	use 3/4”	10	10	11	12	12
1200	use 3/4”	10	10	11	11	11
1300	use 3/4”	10	10	11	11	11
1400	use 3/4”	9	9	11	11	11
1500	use 3/4	“use 3/4”	use 3/4”	10	10	10

1. Table assumes plywood is continuous over two or more spans. For simple spans, use 200: or the value of the computed form pressure.
2. Table assumes plywood face piles are parallel to the span. If plywood face piles are parallel to supports use 200: or the value of the computed form pressure for 5\8-inch plywood. 133: for 3\4-inch plywood.
3. Table is for plywood having stress values of  $f = 2000$  psi and  $E = 1,600,000$  psi.

(C) **CONSTRUCTION METHODS.** All concrete shall be placed in suitable forms or against excavated earth surfaces. The latter procedure will be allowed only if expressly

permitted by the Chief Engineer. Forms shall be of wood or metal and shall be built mortar-tight. Forms for exposed surfaces shall be so constructed that the surface of the concrete will be smooth and uniform in appearance.

Lagging for the bottom forms of rigid frames or arches shall be not less than 1-1/4 inch nominal thickness for joists spaced 21 inches to 24 inches, and not less than 1 inch nominal thickness for joists spaced 20 inches or less and shall be lined with 3 ply plywood. Curved surfaces shall accurately follow the required radii. Forms shall be mitered at all sharp corners and shall be given a bevel or draft for all projections, such as girders and copings, to insure easy removal.

Plywood sheets for form lining on exposed surfaces shall be placed symmetrically between joints, for symmetry in appearance of the concrete surface.

Temporary openings shall be provided at the bottom of the forms for narrow walls and piers where necessary to facilitate cleaning before depositing concrete.

Suitable milled triangular beveled moldings approximately 3/4 inch on the square sides of such size as directed, shall be placed in the angles for the forms to chamfer the exposed edges of the concrete, including the abutting edges of expansion joints.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 2 inches from the face without injury to the surface of the concrete by spalling or otherwise. In exposed surfaces or concrete, metal ties or anchorage shall not be fitted with any lugs, cones, washers or other device to act as a spreader within the forms, or which will leave a hole larger than 7/8 inch diameter or a depression. Ties designed to break off back of the surface of concrete will not be permitted. Wire ties will not be permitted. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size.

All forms shall be set and maintained true to the line designed until the concrete has sufficiently hardened. Forms shall remain in place for periods which shall be determined as specified herein. When forms appear to be unsatisfactory in any way, either before or during placing of concrete, the Chief Engineer will order the work stopped until the defects have been corrected.

The shape, strength, rigidity, water-tightness and surface smoothness of reused forms shall be maintained at all times. Any warped or bulged lumber must be resized before being reused. Forms which are unsatisfactory in any respect shall not be reused.

The inside surface of forms shall be soaked with clean water and kept wet for 12 hours before any concrete is placed. In case forms have been erected for some time and have become dry so that joints have opened then the forms shall be thoroughly soaked until the joints have closed. Forms for exposed surfaces and forms intended to be reused shall be treated with oil before erection of the forms or before placing reinforcing steel in the forms. The oil used for this purpose shall be clear, paraffin base oil which will not stain or discolor the concrete surface. Excess oil shall be wiped off with rags to leave the surface of the forms just oily to the touch.

**703.15 TEMPORARY STEEL BRIDGE DECK FORMS**

- (A) **GENERAL** – The use of temporary steel forms in constructing the new bridge deck shall be optional. These forms shall be considered temporary for construction of the deck and shall be promptly removed when the deck has obtained sufficient strength to support all anticipated loads. Stay-in-place forms shall not be used.
- (B) **MATERIALS** – Temporary steel bridge deck forms and supports shall be fabricated from steel conforming to ASTM Specification A653 (Grade A through E) having a coating class of G165 according to ASTM Specification A653.
- (C) **DESIGN** – The following criteria shall govern the design of temporary steel bridge deck forms:
- (1) The steel forms shall be designed on the basis of form dead load, reinforcement and plastic concrete plus 50 pounds per square foot for construction loads. The unit working stress in the steel sheet shall be not more than 0.725 of the specified minimum yield strength of the material furnished, but not to exceed 36,000 pounds per square inch.
  - (2) Deflection under the weight of the forms, the plastic concrete and reinforcement shall not exceed 1/180 of the form span or 1/2 inch, whichever is less, but in no case shall this loading be less than 120 PSF total. The permissible form camber shall be based on actual load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits.
  - (3) The design span of the form sheets shall be the clear span of the form plus 2 inches measured parallel to the form flutes.
  - (4) Physical design properties shall be computed in accordance with requirements of the American Iron and Steel Institute Specification for the Design of Cold Formed Steel Structural Members, latest published edition.
  - (5) Bottom reinforcement shall have a minimum concrete cover of 1 inch.
  - (6) The plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck shall be maintained.
  - (7) Temporary steel bridge deck forms shall not be considered as lateral bracing for compression flanges of supporting structural members.
  - (8) Temporary steel bridge deck forms shall not be used in panels where longitudinal deck construction joints are placed between stringers.
  - (9) Welding to structural steel shall not be permitted. Forms shall be attached to steel members by the use of clamps or other approved mechanical devices which make the forms easily removable without the application of heat.
  - (10) Fabrication, shop and erection drawings shall be submitted to the Chief Engineer for approval. These plans shall indicate the grade of steel, the physical and section properties for all temporary steel bridge deck form sheets and a clear indication of locations where the forms are supported by steel beam flanges subject to tensile stresses.

- (D) CONSTRUCTION** – All forms shall be installed in accordance with approved fabrication and erection plans.

Form sheets shall not be permitted to rest directly on top of the stringer or floor beam flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1 inch at each end. Form supports shall be placed in direct contact with the flange of stringer or floor beam. All attachments shall be made by permissible bolts, clips, or other approved means. The attachments shall be designed to facilitate easy removal of the temporary steel deck forms. Welding shall not be permitted.

- (E) PLACING OF CONCRETE** – Concrete shall be placed in accordance with the contract specifications. Particular emphasis should be placed on proper vibration of the concrete to avoid honeycombs and voids, especially at construction joints, expansion joints, and valleys and ends of form sheets. Placement sequences, procedures and mixes shall be approved by the Chief Engineer.

Calcium chloride or any other admixture containing chloride salts shall not be used in the concrete placed on temporary steel bridge deck forms.

When, in the opinion of the Chief Engineer, the concrete bridge deck has attained sufficient strength to support all anticipated dead and live loads, the temporary steel bridge deck forms shall be removed and properly disposed of by the Contractor.

- (F) INSPECTION** – The Contractor's method of construction shall be carefully observed during all phases of the construction of the bridge deck slab. These phases include installation of the metal forms; location and fastening of the reinforcement; composition of concrete items; mixing procedures; concrete placement, vibration and finishing of the bridge deck and removal of the forms. Should the Chief Engineer determine that the procedures employed during concrete placement warrant inspection of the underside of the deck, the Contractor shall remove at least one section of the forms at locations and times selected by the Chief Engineer for each span in the contract. This should be done as soon after placing the concrete as practicable in order to provide visual evidence that the concrete mix and the Contractor's procedures are obtaining the desired results. An additional section shall be removed if the Chief Engineer determines that there has been any change in the concrete mix or in the Contractor's procedures warranting additional inspection.

After the deck concrete has attained adequate strength, the forms shall be removed and disposed of properly. This removal is considered part of the required work and shall be at no additional cost to the District.

As soon as the forms are removed, the concrete surface will be examined for cavities, honey-combing and other defects. If irregularities are found and it is determined by the Chief Engineer that these irregularities do not justify rejection of the work, the concrete shall be repaired as the Chief Engineer may direct and shall be given an Ordinary Surface Finish in accordance with the concrete specifications.

The Contractor shall provide all facilities as are reasonably required for the safe and convenient operation of the Chief Engineer's inspection procedures.

**703.16 FALSEWORK AND CENTERING**

- (A) **DESIGN** – The Contractor shall engage the services of a professional engineer (P.E.) registered in the District of Columbia, which P.E. shall have a minimum of five (5) years experience in falsework design for bridge construction and repair, to design the falsework for the project.

In the event there is more than one structure in the project, each structure shall require a separate falsework design analysis as specified herein. This requirement applies even when structures appear to be identical.

All falsework shall be designed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Falsework shall be set with the necessary camber so that the completed structure will be true to the lines and grades shown in the contract documents. Suitable means shall be provided to take up any settlement in the falsework either before or during the placing of concrete.

Each falsework system shall be designed to have the capacity to support all vertical and horizontal loading with enough redundancy to prevent progressive failure. Vertical loading, differential settlement forces, live load where applicable and all horizontal lateral and longitudinal forces shall be taken into account. Unbalanced temporary loading caused by placement sequence shall be provided for in the design. Adequate diagonal bracing in all planes shall be employed. The falsework drawings shall contain information on materials to be used and on procedures for erection.

When falsework installations are to be erected adjacent to a highway, special design consideration and protection shall be taken to ensure that the falsework system is not disturbed by errant highway vehicles or by the vibration forces caused by passing vehicles. Designs shall provide for protection against accidental collision of a crane boom or other construction equipment and vehicles, flood waters, high winds and any other envisioned contingent situations.

All designs and drawings for falsework systems shall provide for possible settlement and shall have adequate foundations with bearings below the frost line, on rock or piling. If additional subsurface data is necessary, it shall be obtained by the Contractor and analyzed by the P.E. for proper design of the falsework assembly and performance of construction, all at no additional cost to the District.

- (B) **SUBMITTALS** – Prior to commencement of construction, designs for falsework shall be submitted for approval in accordance with 105.02. Work on the falsework shall not be started before approved plans are available.

The design calculations and working and erection drawings for falsework submitted by the Contractor shall be signed by the registered Professional Engineer (P.E.) who prepared these calculations and drawings and shall bear the P.E.'s seal. The submittal of the design and falsework drawings shall include the P.E.'s resume showing evidence of the required experience as heretofore specified.

The P.E.'s plans and design calculations shall evaluate and qualify all manufactured items for their intended service. Approval by the District of falsework systems shall not in any way relieve the Contractor of his/her responsibility for the safety and adequacy of

the design and construction for the falsework systems and operations, including all components. The Contractor's contracts with his/her suppliers, subcontractors and manufacturers shall state their complete responsibility for the design and quality of their products and components including manufactured products and proprietary items.

- (C) **CONSTRUCTION** – The Contractor shall not proceed with construction of falsework until approval of working drawings, submitted in accordance with 703.16(B) has been obtained from the District.

The falsework shall be constructed and maintained in accordance with the approved working drawings. Subsequent to approval any changes to the falsework design proposed by the Contractor through his professional engineer shall be resubmitted for approval in accordance with 703.16(B).

After assembly of the falsework system and before permitting any loads to be placed on falsework, the Chief Engineer shall receive written certification by the Contractor's professional engineer that the falsework system has been erected according to the approved falsework drawings. This certification shall be accompanied by a Certificate of Compliance stating that all manufactured materials and assemblies fully comply with the falsework design and drawings. Upon inspection of the falsework system, the Chief Engineer may require that testing be performed on any of the materials or assemblies. The costs of such testing shall be borne by the Contractor.

Falsework shall be set with the necessary camber so that the completed structure will be true to the lines and grades shown on the plans. A "telltale" or other approved type indicator shall be attached to the forms in a manner to indicate any settlement, movement or deflections in the forms or falsework. Should any indicator show settlement, movement or deflection in excess of the prescribed tolerance(s), the work shall be stopped and the Contractor shall be required to rectify the problem to the full satisfaction of the Chief Engineer at the Contractor's expense.

In addition to protective measures shown on the falsework drawings, the Chief Engineer may direct the Contractor to provide such further protection of falsework, which measures in the Chief Engineer's judgement are necessary for public safety and protection of the work.

In the event falsework is moved from one structure to another, the falsework shall be thoroughly inspected and approved by the Contractor's Professional Engineer, (P.E). The falsework shall not be moved until the P.E.'s certification is reviewed and approved by the Chief Engineer.

### **703.17 REMOVAL OF FALSEWORK AND FORMS**

Falsework for deck forms shall not be removed until the deck slab concrete has attained a minimum compressive strength of 4,500 psi.

In the determinations of the time for the removal of falsework and forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of concrete, and the materials used in the mix. When stripping concrete forms is not controlled by means of cylinder strength, the following minimum periods,

exclusive of days when the temperature drops below 40°F, may be used as a guide for removal of forms and supports which shall not be removed without the approval of the Chief Engineer.

Walls, piers, footings, and side forms	12 to 24 hours
Floor slabs	8 to 14 days
Concrete superstructure, beams, arches	14 days
Rigid frames	14 days
Columns	2 to 7 days

Methods of form removal likely to cause overstressing of the concrete shall not be used. In general, forms shall be removed from the bottom upward. Particular care shall be taken in the removal of side forms before the concrete has attained considerable strength and hardness, to avoid breaking exposed edges or corners or spalling the surface.

### 703.18 CURING CONCRETE STRUCTURES

(A) **GENERAL REQUIREMENTS.** All concrete shall be cured and protected as specified herein. Before placing the concrete, the Contractor shall make all necessary arrangements for curing and protecting the concrete.

Concrete not covered by forms shall be cured using either of the following two systems for a period of seven (7) days:

- (1) Two (2) layers of burlap meeting the requirements of 814.01, covered with one (1) layer of white polyethylene film, meeting the requirements of 814.02(A).
- (2) One layer of burlap covered with one (1) layer of white burlap-polyethylene sheet meeting the requirements of 814.02(C).

The burlap and burlap portion of the white polyethylene film shall be saturated with water before it is placed in position, and maintained in a saturated condition by a continuous supply of water distributed by suitable means such as soaker hoses. The above described curing materials shall be placed as soon as it is determined by the Chief Engineer that the concrete is hard enough to prevent marring during placement of the curing material. The curing materials shall be sufficiently secured to ensure that the entire area remains covered and wet for the required period.

Wood forms shall likewise be kept wet for the seven (7) day curing period.

At the ambient air temperature of 80°F (27°C) and below, the use of a resin-based pigmented liquid curing compound, meeting the requirements of 814.03, may be permitted immediately after final finishing of the concrete. Whether or not a curing compound is used, one of the abovementioned two (2) curing systems shall be applied as specified.

At ambient air temperatures between 80°F (27°C) and 85°F (29°C), the use of the resin-based pigmented liquid curing compound shall be required immediately after the final finishing of the concrete. One of the abovementioned two (2) curing systems shall be applied as specified as soon as it is determined by the Chief

Engineer that the finished concrete is hard enough to prevent marring during placement of the curing system.

The pigmented liquid curing compound shall be applied at a minimum rate of one gallon per 200 square feet. Application shall be such that an even, continuous membrane is produced on the concrete surface.

When directed by the Chief Engineer, the Contractor shall be required to take precautions as specified in Section 2.1.5 of ACI 305R to prevent plastic shrinkage cracking.

The requirements of this section relative to keeping concrete surfaces saturated at all times will be strictly enforced. The Contractor shall furnish a sufficient water supply and personnel on a 24 hour basis to satisfy the requirements specified herein.

**(B) CONCRETE BRIDGE DECK SLABS.** Concrete bridge deck slabs and other structural slabs shall be cured by using one of the following methods for a period of seven (7) days.

- (1) Two (2) layers of burlap meeting the requirements of 814.01, covered with one (1) layer of white polyethylene film meeting the requirements of 814.02(A) shall be placed to assure that the entire deck surface is covered. The burlap shall be well secure at all times. A continuous supply of water will be required during the curing period to assure that the burlap and concrete surfaces are saturated at all times.
- (2) One (1) layer of burlap covered by one (1) layer of white burlap-polyethylene sheet meeting the requirements of 814.02(C) may be used. The burlap-polyethylene shall be well secured to ensure that the entire deck surface will be covered at all times. A continuous supply of water will be required to assure that the burlap and concrete surfaces are saturated at all times.

At an ambient air temperature of eighty (80) degrees Fahrenheit and below, the use of clear liquid curing compound immediately after finishing may be permitted. Whether a curing compound is used or not, one of the above three curing methods shall be applied as soon as it is determined by the Chief Engineer that the finished deck concrete is hard enough to prevent marring during placement of the curing methods.

In areas where continuous dripping water from the deck may create problems and/or hazards to the public the Contractor shall be required to submit to the Chief Engineer for approval alternate methods of curing or means of diverting the runoff water.

The requirements for keeping the concrete surfaces saturated at all times will be strictly enforced. The Contractor shall be required to furnish a sufficient water supply and personnel on a 24 hour basis to satisfy these requirements.

### **703.19 FINISHING EXPOSED CONCRETE STRUCTURES**

**(A) GENERAL.** Forms of exposed surfaces shall be removed when permitted by the Chief Engineer, without delay, to facilitate any necessary patching, cleaning or surface treatment as required herein to provide a satisfactory finished appearance.

After removing forms, all fins and irregular projections shall be removed from exposed surfaces. On all surfaces, cavities produced by form ties, and all other holes, honeycomb

spots, broken corners or edges and other defects shall be thoroughly cleaned and saturated with water for not less than 3 hours immediately before repairs are made. They shall be filled with mortar composed of 1 part cement to 2 parts of fine aggregate by volume. The cement portion shall be composed of varying quantities of white cement mixed with the cement used on the job. Trial batches shall be made up and used for patching on concealed surfaces until a satisfactory matching color is obtained for use on exposed surfaces.

Any honeycombed concrete shall be chipped away to such depth that all voids have been entirely removed. The edges of the materials remaining in place shall be cut perpendicular to the finished surface to the average depth of the material removed, but not less than 1 inch. All surfaces of the cavity shall be thoroughly cleaned and saturated with water. The cavity shall then be filled with concrete composed of the same kind of materials and proportions as in the surrounding concrete and shall be properly compacted. The concrete shall be cured as specified in 703.18.

- (B) GROUT CLEANING.** Unless otherwise specified in the contract documents, exposed concrete surfaces shall be grout cleaned as follows:

Grout made with 1 part portland cement and 1-1/2 parts fine sand and sufficient water to produce a consistency of thick paint, shall be applied uniformly to the concrete surface with brushes or spray guns so as to completely fill air bubbles and holes. White portland cement shall be used for all or part of the cement in the grout, as directed by the Chief Engineer, to give the color desired. The surface of the concrete before applying the grout shall be sufficiently wet to prevent absorption of water from the grout. Immediately after applying the grout, the surface shall be floated with a cork float, scoring the wall vigorously. While the grout is still plastic, the surface shall be finished with a sponge rubber float, removing all excess grout. This finishing shall be done at the time when the grout will not be pulled from the holes or depressions. The surface shall then be allowed to dry thoroughly and then rubbed vigorously with dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining after this rubbing. Upon completion of the grout cleaning, any dark spots or streaks shall be wiped off lightly with a fine abrasive hose without using water.

- (C) ALTERNATE SURFACE FINISH.** Brushed on coatings may be used in lieu of the grout cleaning if approved by the Chief Engineer. A test panel shall be finished to determine the color and texture characteristics.

### **703.20 MASONRY BEARING AREAS AND ANCHOR BOLTS**

- (A) MASONRY BEARING AREAS.** At the option of the Contractor, masonry bearing areas may be grouted, as herein set forth and shown on the plans; otherwise they shall be placed approximately 1/4 inch high and honed or ground level to within 1/16 inch (plus or minus) of proper elevation. Unless otherwise shown on the plans, when bearing plates are set on ground or honed surfaces, a sheet of 70 durometer neoprene 1/8 inch in thickness meeting the requirements of 822.02 (C) or preformed fabric pads meeting the requirements of 822.02(A) with holes provided for anchor bolts, shall be placed between the masonry and the bottom of the plates.

If grouted, the bearing areas shall be set into the masonry surface 1 inch, so as to assure a pad edge thickness of at least 1 inch. Grouting methods shall be such that the entire space between masonry and plate is completely filled, and masonry bearing plates and shoes shall have full uniform bearing on the substructure masonry. They shall be carefully located and rigidly held to correct alignment and elevation during the grouting operation. With the permission of the Chief Engineer, small holes may be drilled in the masonry plates to permit the escape of air trapped during grouting. The grout shall be non-shrink and the mix proportions shall be 1 part cement and 1-1/2 parts sand. Cement and sand shall first be thoroughly mixed dry before adding clean, fresh water to produce the required consistency. Grout shall be mixed only in those quantities required for immediate use. Grout that is not used within 45 minutes after water has been added shall be discarded. Re-tempering of grout will not be permitted. No superimposed load shall be placed on the bearing plates until the grout has set for at least 48 hours. No grouting shall be done in freezing weather. Grout shall be protected and kept moist for at least 3 days after grouting. After the grout has set sufficiently, the edges of the grout pad shall be finished to a slope of 45 degrees.

- (B) ANCHOR BOLTS.** All necessary anchor bolts in piers, abutments, or pedestals shall be accurately set in the concrete masonry as it is being placed, in holes formed while the concrete is being placed, or in holes drilled after the concrete has set. If set in the masonry as it is being placed, anchor bolts shall be positioned by means of a suitable template and otherwise held rigidly in place by means of wires, blocks or other means satisfactory to the Chief Engineer. The template shall be so arranged that the concrete bearing area, if poured high as specified herein, may be readily accessible for proper finishing.

Holes, if drilled, shall be at least 1 inch larger in diameter than the bolts used, or in accordance with the manufacturer's recommendations if epoxy compound installations are used. Holes shall be drilled utilizing a template to insure proper alignment. Holes shall be carefully cleaned after drilling to remove all drilling residue. Where dry drilling is employed, the holes shall be vacuumed or blown out using oil-free compressed air. Where the drilling process requires the use of water, holes shall be carefully washed out after drilling to remove any drilling slurry residue and then be permitted to dry prior to placing bolts. Provisions shall be made to protect unfilled holes against rupture in freezing weather.

The Contractor shall anticipate that reinforcing bars or utilities may be encountered while drilling holes in concrete. The use of diamond bit drilling or other special procedures necessary to drill through reinforcing bars shall be included as part of the work. The Contractor shall be responsible for any damage to electrical conduits, utilities or the structure. The repair of any damage shall be included as part of the work. When drilled holes are utilized for new construction the Contractor shall adjust the reinforcement prior to placing the concrete so that drilling through reinforcement will not be required.

Anchor bolts and bolt holes shall be thoroughly clean and dry at the time of bolt installation. Any grease encountered shall be removed with toluene. The bolts shall be set accurately as to location and projection and fixed with grout completely filling the holes. The grout shall be a pourable epoxy mortar conforming to 806.05(C) and 822.08(B) (2). Conditions and directions for use shall conform to the manufacturer's directions. Templates shall be used to hold the bolts in position until the grout cures. Temperatures

at the time of installation shall be 35°F or above and both holes and bolts shall be free of frost. Curing temperatures of above 25°F shall be maintained.

Exposed portions of anchor bolts shall be thoroughly cleaned and painted within three days, but not less than eight hours after installation to protect the masonry from rust stains.

Anchor bolts for hand railing shall, unless otherwise required, be set in the masonry as it is being placed, positioned by means of templates and otherwise be held rigid as outlined herein.

Should the exposed portion of anchor bolts become dirty or rusty prior to setting the shoes, the Contractor shall thoroughly clean and paint the anchor bolts before setting shoes. All portions of anchor bolts and anchorage metal exposed after erection of shoes shall be painted as provided for in 707.

### 703.21 BRIDGE DECKS AND APPROACH SLABS

- (A) **GENERAL.** All bridge deck concrete shall be placed in conformance with 703.07 and cured in conformance with 703.18(B).
- (B) **MACHINE FINISHING.** Machine finishing of bridge decks and approach slabs is required. Equipment for finishing shall be in accordance with 905.06(B). A rolling bridge shall be located on the finishing machine rails behind the finishing machine for the use of the Contractor and for inspection and testing.

Prior to beginning concrete placement operations, the finishing machine shall be operated over the full area of the slab to be constructed. This test shall be made with the machine adjusted to its finishing position. While operating the finishing machine in this test, the screed rails shall be checked for deflection and proper adjustment, the cover on slab reinforcement measured and controlling dimensions of slab thickness checked. All necessary corrections shall be made at least four (4) hours before concrete placement and operations begin.

After the concrete has been placed, spread, and consolidated to provide a uniformly dense structural slab, the surface shall be struck off immediately by the passage of the finishing machine. A sufficient quantity of concrete shall be in place in front of the auger to preclude low and porous areas. The oscillating travel of the auger and cylinder device shall be repeated as necessary to produce a uniformly consolidated, dense, smooth surface of the required contour.

After passage of the finishing machine, any irregular or unsealed surface shall be floated with a float meeting the requirements of 905.09(C). No water shall be applied to the slab surface during the finishing process.

Immediately after floating, the surface shall be tested for irregularities with a straightedge per 903.03. All slab sections shall be tested with a straightedge parallel to traffic flow. The straightedge shall be used to test the surface for longitudinal trueness. All depressions and high spots of more than 1/8 inch in 10 feet must be corrected as directed by the Chief Engineer. If a surface fails to meet these tolerances, the Contractor shall

correct the deficiency at the Contractor's expense. In testing the surface, successive positions of the straightedge shall be lapped 1/2 its length.

All depressions and high spots of more than 1/8 inch in 10 feet which exist in the hardened concrete shall be corrected in a manner as directed by the Chief Engineer at the Contractor's expense.

- (C) **TEXTURING.** Texturing is required for the entire concrete bridge deck and approach slab riding surfaces, except for a 12-inch wide gutter surface adjacent to the curb or face of traffic barrier. The purpose is to create a suitable skid resistant riding surface for the finished structure.

The method of bridge deck texturing by saw cutting grooves shall be used.

The grooving operation shall not be started until the bridge deck has been cured in accordance with the specifications and attained a minimum compressive strength of 3,000 psi. The bridge deck shall be grooved perpendicular to the center line.

The grooves shall be cut into the hardened concrete using a mechanical saw device which will leave grooves 1/8 in. wide,  $3/16 \pm 1/16$  in. depth and variably spaced from 5/8 to 7/8 in. apart.

The grooves shall extend across the slab to within 1 ft. of the gutter lines. The transverse grooving shall not cut across joints, but shall stay clear by  $2 \pm 1$  in. on each side.

Slurry from the grooving operation shall not be permitted to accumulate on adjacent lanes to the extent that it would create a slippery or hazardous condition. Solid residue resulting from grooving operations shall be removed from pavement surfaces. The removal of all debris (slurry, etc.) resulting from the grooving operations shall be continuous. Pavement shall be immediately left in a washed clean condition, free of all slipperiness from the slurry, etc.

All debris and surplus material removed from the grooving operations shall be deposited in a truck or other conveyance and removed from the project. The slurry shall not be disposed of in the existing drains or on the slopes of the roadway, but shall be removed from the project and disposed of by the Contractor.

### **703.22 SIDEWALK, MEDIAN AND CURB FINISH**

Immediately after the concrete has been deposited in place, it shall be consolidated and screeded with a surface variation tolerance of 1/8 inch in 10 feet. The sidewalk and median surfaces shall be troweled to a dense, smooth surface, after which it shall be broomed transversely with a broom meeting the requirements of 905.09(D)(2), to produce a slightly roughened surface which will not be slippery.

All scoring shall be done with a jointing tool having a blade projection of 1/2 inch and minimum borders of one and 1-1/2 inches.

The jointing tool for scoring the line back of the curb shall be one piece to include the edge radius at the top of the curb. All borders shall be removed in the brushing operation.

Forms for curbs shall be designed so that they will not deflect more than 1/16 inch at any point during concrete placement.

On island noses and other short radius curbs form work shall be lined with 1/4 inch plywood or masonite or other approved liners.

The curb forms shall remain in place a minimum of 12 hours, and during periods of low temperatures (below 40°F), they shall not be removed in less than 36 hours. The forms shall be removed within 60 hours after the concrete has been deposited against them. After removal of the forms all fins and burrs shall be immediately removed and cavities produced by joints, projections and air pockets shall be filled by grout cleaning as specified in 703.19(B).

Curing of sidewalk, medians and curbs shall be as outlined for slabs in 703.18.

### **703.23 TOLERANCES**

Where tolerances are not otherwise specified in the contract documents, deviations from the established dimensions will be permitted to the extent set forth below. The Contractor shall set and maintain concrete forms so as to insure completed work within the tolerance limits herein indicated.

#### **(A) FOOTINGS.**

1. Variations in dimensions in plan: Minus 1/2 inch to Plus 2 inches.
2. Misplacement or eccentricity: 2 percent of the footing width in the direction or misplacement but not more than 2 inches.
3. Reduction in thickness: Minus 5 percent of specified thickness.

Applies to concrete only, not to reinforcing bars or dowels.

#### **(B) WALLS, PIERS, COLUMNS.**

1. Variation from the plumb or the specified barrier: Exposed, 1/2 inch in 10 feet; Backfilled, 1 inch in 10 feet.
2. Variation in cross-sectional dimensions (also including beams: Minus 1/4 inch to Plus 1/2 inch.

#### **(C) BRIDGE SLABS.**

1. Variation in thickness: Minus 1/8 inch to Plus 1/4 inch.

### **703.24 CONCRETE BONDING WITH EPOXY**

Where indicated on the plans, epoxy adhesive, conforming to 822.08(B)(1), shall be used to bond new concrete to old concrete. A manufacturer's certification that the material conforms to the specifications shall be submitted prior to use.

The application shall conform to the manufacturer's directions.

Concrete surfaces to be bonded shall be structurally sound and free from foreign materials. Sandblasting, either wet or dry, shall be used in preparing sound concrete surfaces for new concrete, and shall be performed in such a manner as to remove all dirt, grease, paint, loose and unsound concrete and other foreign material and expose a clean surface of sound concrete over the entire area to be treated. Suitable traps and filters shall be utilized with sandblast equipment to prevent oil from being deposited on surfaces.

Payment for epoxy bonding will be included in the price for the appropriate concrete bid item.

### **703.25 MEASURE AND PAYMENT**

The unit of measure for the various items of concrete listed in the Schedule of Prices will be the cubic yard. The number of cubic yards will be the volume determined from the dimensions shown on the plans.

The volume of emblems, reinforcement, chamfers, conduits, boxes, metal pipe sleeves, scuppers, manholes, piling and other inserts will not be deducted from the gross volume measured.

The number of cubic yards of concrete measured will be paid for at the contract unit price per cubic yard for the various items of concrete listed in the Schedule of Prices, which payment will include emblems, reference marks, water stops, performed joint filler, poured joint seals, dove-tailed slots for stone anchors, bearing pads, and other similar materials, except for reinforcing steel. Also included will be all the labor, materials, tools, equipment and incidentals necessary for proportioning, mixing, forming, placing, finishing and curing the concrete. Included in the cost of Superstructure Concrete will be the setting of manhole frames and covers but not the furnishing of these items. Texturing of the surfaces of bridge decks and approach slabs is included in the cost of these items. Anchor bolts will be furnished and paid for under Structural Steel, Section 706. The setting of anchor bolts will, however, be included in the contract unit price for the respective class of concrete in which they are located.

## 704 REINFORCING STEEL

### 704.01 DESCRIPTION

This work shall consist of furnishing and placing uncoated or epoxy coated reinforcing steel.

### 704.02 MATERIALS

Reinforcing steel shall meet the requirements of 812.02 or 812.03. The use of only one grade of steel will be allowed for bar reinforcement unless otherwise permitted in writing by the Chief Engineer. All mill tests for reinforcing steel shall be certified for each heat of steel not only as to test results but also to physical and chemical requirements of these specifications. Extra bars shall be furnished for field sampling and tests. A sample is required for each 25 tons or fraction thereof for each size of bar used. Samples shall be cut from the steel after delivery, as directed by the Chief Engineer.

### 704.03 SHOP DRAWINGS

Shop drawings, including placement drawings and bending diagrams, shall be submitted in accordance with 105.02. No materials shall be ordered until such drawings are approved. Bar lists, including weights shall be submitted to the Chief Engineer.

### 704.04 FABRICATION

Bent-bar reinforcement shall be cold bent to the shapes shown on the plans, and unless otherwise provided on the plans or by authorization of the Chief Engineer, the bends shall be made in accordance with the following requirements:

- (1) BENDS. Hooks and stirrups shall be bent using dimensions and diameters defined by “ACI Standard Hooks” in the Manual of Standard Practice or CRSI.
- (2) EMBEDDED BARS. Bars partially embedded in concrete shall not be bent except as shown on the plans or as approved by the Chief Engineer.
- (3) MARKING. Bar reinforcement shall be shipped in bundles, tagged and marked in accordance with the Code of Standard Practice of the Concrete Reinforcing Steel Institute.

### 704.05 PROTECTION OF MATERIALS

Bars, after placement, shall be free of damage, oil, loose mill scale and loose rust. Bars with thin powdery rust, tight rust, mill scale or a combination thereof will be acceptable without cleaning provided that upon removal of all loose rust and scale by wire brushing, bars meet both minimum weight and deformation requirements. The Contractor shall bear any expense associated with cleaning, testing or replacement of damaged bars as directed by the Chief Engineer.

### 704.06 PLACING AND FASTENING

Placement and reinforcing steel shall conform to the requirements of CRSI “Recommended Practice for Placing Reinforcing Bars” except as modified herein.

- (A) **TIES.** All steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete. Reinforcing bars in the top mat of bridge decks and sidewalks shall be tied at all intersections. Reinforcing bars in the bottom mat of bridge decks and sidewalks shall be tied at alternate intersections. Other reinforcement shall be tied at all intersections where the spacing is 9 inches or more in any direction. Where the spacing is less than 9 inches in each direction, reinforcement shall be tied at alternate intersections.
- (B) **BOLSTERS.** Distances from the forms and layers of bars shall be maintained by means of manufactured metal spacers, bolsters, chairs or other approved supports. Metal spacers, bolsters, or chairs which are in contact with the forms shall be galvanized, plastic coated, stainless steel or other approved material. Catalog cuts of spacers, bolsters, or chairs intended for use shall be submitted to the Chief Engineer for approval. Blocks for holding reinforcement from contact with forms or earth shall be suitably cured precast mortar blocks of approved shape and dimensions. The use of pebbles, stone, bricks, metal pipes, wooden blocks, or other unsuitable materials will not be permitted.
- (C) **INSPECTION.** Reinforcement in any member shall be inspected and approved by the Chief Engineer before the placing of concrete begins. Ample time, as determined by the Chief Engineer, shall be provided for the inspection of reinforcement prior to concrete placement. Concrete placed before inspection and approval of the reinforcement by the Chief Engineer shall be cause for rejection and removal of the concrete.
- (D) **DOWEL BARS.** Dowel bars shall be securely supported prior to the start of concrete placement and shall not be stuck into the concrete after the concrete is placed.
- (E) **BAR COVER.** The minimum clear distance from the face of concrete to any reinforcing bar shall be maintained as specified herein or as shown on the contract drawings. In superstructures, the cover shall be at least 2 ½ inches except as follows:
- (1) Bottom of Slab: 1 ¼ inches.
  - (2) Stirrups and Ties in T-beams: 1 ½ inches.
  - (3) Rails, Rail Posts, Curbs, and Parapets: 1 inch.
- In substructures, the minimum cover shall be at least 3 inches except as follows:
- (1) Abutment neat work and Pier Caps: 2 ½ inches.
  - (2) Spirals and Ties: 2 inches.

#### 704.07 SPLICING

All reinforcement shall be furnished in the full lengths indicated on the plans or approved shop drawings unless otherwise permitted. Splicing of bars, except where shown on the plans or approved shop drawings, will not be permitted without approval. Splices shall be staggered as much as possible. Unless otherwise shown on the plans, bars shall be lapped 30 diameters to make the splice. In lapped splices; the bars shall be placed and wired in such a manner as to maintain the minimum distance to the surface of the concrete shown on the plans. Lapped splices shall not be used for Nos. 14 and 18 bars. Welding of reinforcing steel and other positive connections shall be used only if detailed on the plans or if authorization is made by the Chief Engineer in writing. Welding shall conform to "Structural Welding Code -

Reinforcing Steel” AWS D 1.4 and applicable special provisions. In bars required for compression only, the compressive stress may be transmitted by bearing of square cut ends held in concentric contact by a suitable device. Ends shall terminate in flat surfaces within 1-1/2 degrees of right angles to the axis of the bars and shall be fitted within 3 degrees of full bearing after assembly. End bearing splices shall not be used except in members containing closed ties, closed stirrups, or spirals.

#### 704.08 SUBSTITUTIONS

Substitution of different size reinforcing bars will be permitted only with specific authorization by the Chief Engineer. If a substitute is authorized, it shall have an area equivalent to the design area, or larger.

#### 704.09 EPOXY COATED BARS

- (A) **CERTIFICATION.** The coating applicator shall furnish to the Chief Engineer, at the time of shipment, written certification that the coated reinforcing bars were cleaned, coated, tested, and repaired in accordance with AASHTO M 284.
- (B) **FABRICATION.** The Contractor shall notify the Chief Engineer of the date and location of fabrication and coating to allow inspection and testing of epoxy coated reinforcing steel before shipment to the project site.

All systems for handling coated bars shall have padded contact areas. Nylon strapping or padded bundling bands shall be used. The bars or bundles shall not be dropped or dragged.

Drive rolls on shear beds and back-up barrels on benders shall be protected with a suitable plastic covering to minimize damage during the fabrication process.

Coated bars shall be stored on wooden or padded cribbing.

The fabricator shall maintain the identity of the coated bars, and shall assure that the coated, fabricated bars are identified with proper tags for final shipment to the job site.

Repair will be required within each fabricated area of the reinforcing bar when bond loss and damage exist. When repair is required, all damage within each area shall be cleaned and repaired. The cleaning shall remove loose or deleterious material or both. In case where rust is present, it shall be removed by blast cleaning prior to repair. Repair material shall conform to AASHTO M 284.

Hairline cracks without bond loss or other damage need not be repaired.

The repairs shall be performed as soon as possible and before oxidation appears.

- (C) **INSTALLATION.** All systems for handling coated bars shall have padded contact areas. The bars or bundles shall not be dropped or dragged. Coated bars shall be stored on wooden or padded cribbing.

Coated bars shall be tied with coated tie wire or any suitable material acceptable to the Chief Engineer that will not damage or cut the coating.

The coated bars shall be installed on plastic coated or epoxy coated wire supports.

If welded splices are required or permitted, suitable ventilation shall be provided.

After completion of welding on coated reinforcing bars, coating damage shall be repaired in accordance with 704.09(D). All welds, and all steel splice members when used to splice bars, shall be coated with the same material used for repair of coating damage.

When required or permitted, mechanical connections shall be installed in accordance with the splice device manufacturer's recommendations.

After installing mechanical connections on coated reinforcing bars, coating damage shall be repaired in accordance with 704.09(D). All parts of mechanical connections used on coated bars, including steel splice sleeves, bolts, and nuts shall be coated with the same material used for repair of coating damage.

Reinforcing bars partially embedded in concrete shall not be field bent, except as indicated on the contract documents or permitted by the Chief Engineer. When heat is used to field bend coated reinforcing bars, suitable ventilation shall be provided. When coated reinforcing bars are field bent, coating damage shall be repaired in accordance with 704.09(D).

Unless permitted by the Chief Engineer, reinforcing bars shall not be cut in the field. When coated reinforcing bars are cut in the field, the ends of the bars shall be coated with the same material used for repair of coating damage.

**(D) REPAIR.** Repair material shall conform to AASHTO M 284.

Damage caused during shipment of epoxy bars or by installation procedures or both need not be repaired in cases where the damaged area is 1/4 inch by 1/4 inch or smaller and the sum of all damaged areas in each 1-foot length of bar does not exceed 2 percent of the bar surface area. All damaged areas larger than 1/4 inch square shall be repaired and all bars with total damage greater than 2 percent of bar surface area shall be rejected and removed. The total bar surface area covered by patching material shall not exceed 2 percent, including patching performed by the fabricator. All bars cut at the site shall be repaired.

**(E) REJECTION.** Coated bars which do not meet the requirements of this specification shall be rejected. At the Contractor's option, coated bars having defects shall be replaced or alternately, stripped of coating, re-cleaned and recoated in accordance with the requirements of this specification.

#### **704.10 MEASURE AND PAYMENT**

The unit of measure for Reinforcing Steel, coated or uncoated, will be the pound. The number of pounds will be the actual number of pounds of reinforcing steel complete in place as computed from bar lists and will be based on the theoretical weight per linear foot for the particular size of reinforcement used. Should the Chief Engineer, upon request of the Contractor, permit the substitution of larger and heavier bars than are required by the plans, measurement will be made only for the sizes required by the plans. In case short bars are used when full-length bars might reasonably be provided, measurement will be made as if full-length bars were used. No allowance will be made for epoxy coating or for ties, wires,

braces, clips, spacers, supports, chairs, or other similar devices used to support the reinforcement during construction.

The number of pounds of Reinforcing Steel placed, coated or uncoated, will be paid for at the contract unit price per pound, which payment will include all reinforcing steel incorporated in the concrete which is not specifically included in another item or items of the Schedule of Prices. This payment will also include all labor, plant, materials, cleaning and all other expenses necessary for furnishing and placing of steel complete in the work, including the cost of furnishing extra bars as herein specified for sampling.

## 705 PRESTRESSED CONCRETE UNITS

### 705.01 DESCRIPTION

Prestressed concrete units shall be prestressed either by pretensioning or post-tensioning. Pretensioning is defined as any method of prestressing concrete members in which the reinforcement is tensioned before the concrete is placed. Post-tensioning is defined as any method of prestressing in which the reinforcement is tensioned after the concrete is placed.

Unless otherwise specified in the contract documents, the method of prestressing to be used and fabrication site shall be optional with the Contractor, subject to all requirements as outlined in 815.02 and as specified herein.

The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. At the Contractor's option, in lieu of PCI certification, the manufacturer shall, at no cost to the District, meet the following requirements.

1. Retain an independent testing or consulting firm approved by the Chief Engineer.
2. The basis of inspection shall be the Prestressed Concrete Institute's "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products," MNL-116 and "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products," MNL-117.
3. This firm shall inspect the precast plant at two week intervals during production and issue a report, certified by a registered Professional Engineer, verifying that materials, methods, products and quality control meet all the requirements of the specifications, drawings, and MNL-116 and/or MNL-117. If the report indicates to the contrary, the Chief Engineer will inspect and, at the Chief Engineer's option, may reject any or all products produced during the period of non compliance with the above requirements.

### 705.02 MATERIALS

Prestressing Reinforcement - 815.02

Concrete - 817, Class D

Reinforcing Steel - 812.02

### 705.03 EQUIPMENT

The Contractor shall provide all equipment necessary for the construction and the prestressing. Prestressing shall be done with approved jacking equipment. Hydraulic jacks shall be equipped with accurate pressure gauges. The Contractor may elect to substitute screwjacks or other types for hydraulic jacks. In that case, proving rings or other approved devices shall be used in connection with the jacks. All devices, whether hydraulic jack gauges or otherwise, shall be calibrated and, if necessary, recalibrated so as to permit the stress in prestressing steel to be computed at all times. A certified calibration curve shall accompany each device.

Safety measures shall be taken by the Contractor to prevent accidents due to possible breaking of the prestressing steel or the slipping of the grips during the prestressing process.

#### **705.04 CONCRETE CONSTRUCTION**

Necessary formwork, concrete placing, exposed surface finishing and other construction requirements shall conform to 703 unless otherwise stipulated.

The units shall be constructed on a rigid base which will not deflect or settle unevenly, to prevent any vertical distortion, and shall be braced transversely so as to prevent any buckling sideways. No concrete shall be deposited in the forms until the formwork, reinforcing, conduits, anchorages, prestressing steel and other appurtenances have been inspected and approved by the Chief Engineer. Approval, however, does not relieve the Contractor of his responsibility to produce a satisfactory unit, and any unit not meeting the requirements as specified herein will be rejected and the Contractor will be required to replace the unit at his expense.

If the Chief Engineer so directs, the Contractor will be required to vibrate the concrete externally as well as internally. Vibrating shall be done with extreme care and in such a manner as to prevent displacement, crushing or damaging of reinforcement, conduits, wires or any other appurtenances which are a part of the construction.

In post-tensioned construction, connections between end anchorages and conduits or other appurtenances shall be carefully sealed with friction tape or mastic or other satisfactory material, to exclude mortar from such appurtenances during concreting. The prestressing reinforcement shall be moved backward and forward a few inches several hours after pouring concrete to loosen any mortar which might have entered the conduit or other appurtenances.

Curing of concrete shall be per 703.18 except as follows:

- (A) **STEAM CURING.** Steam curing will be permitted and shall be done under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall commence 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place. If the use of retarders is approved, the waiting period before application of the steam shall be from 4 to 6 hours. The steam shall be at least 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam, the temperature of the member shall increase at a rate not to exceed 40°F per hour until a maximum temperature of from 140°F to 160°F is reached. The maximum temperature shall be held until the concrete has reached the desired strength. Suitable probes shall be inserted into the members for monitoring the temperature.
- (B) **RADIANT HEAT CURING.** Precast members may be cured by the radiant heat method provided that the members are enclosed in approved rubberized canvass tarpaulins or other approved enclosures. The application of heat shall be as specified for steam curing.

The Contractor shall submit a curing plan which includes procedures to be used for approval by the Chief Engineer before curing may begin.

**705.05 PRETENSIONING**

The prestressing elements shall be accurately held in position, and stressed by jacks. A record shall be kept of the jacking force and the elongations produced thereby. Several units may be cast in one continuous line and stressed at one time. Sufficient space shall be left between ends of units to permit access for cutting after the concrete has attained the required strength. No bond stress shall be transferred to the concrete, nor end anchorages released, until the concrete has attained a compressive strength, as shown by tests on standard cylinders, made and cured identically with the members, of at least the minimum strength shown in the contract documents. The elements shall be cut or released in such an order that lateral eccentricity of pre-stress will be a minimum. If several strands are tensioned simultaneously, the jacking system shall provide for uniform stress in all strands. Pre-stress in the strands shall be transferred gradually to the concrete upon release.

When units are pre-tensioned, the Contractor shall notify the Chief Engineer a sufficient time in advance on any work to be performed on the units in order that the Chief Engineer or his representative can arrange for inspection.

**705.06 POST-TENSIONING**

- (A) **GENERAL.** Prestressing elements will be accurately placed in the position in the contract documents, and firmly held during the placing and setting of the concrete.
- (B) **ENCLOSURES.** All enclosures shall be metallic and shall be mortar-tight, with the exception that the Contractor, at his option, may form the enclosures by means of cores or ducts composed of rubber or other suitable material which can be removed prior to installing the prestressing reinforcement. Enclosures shall be strong enough to maintain their shape under such forces as will come upon them. They shall be between two and two and one-half times larger in internal diameter than the bar, cable, strand, or group of wires which they enclose. Cores or ducts shall be provided with pipes or other suitable connections for the injection of grout after the prestressing operations have been completed.
- (C) **TENSIONING.** Tensioning of the prestressing reinforcement shall not be commenced until tests on standard cylinders, made and cured identically with the members, show that the concrete has attained at least the minimum strength shown in the contract documents.

After the concrete has attained the required strength, the prestressing reinforcement shall be stressed by means of jacks to the desired tension and the stress transferred to the end anchorage.

The tensioning process shall be so conducted that the tension being applied and the elongation of the prestressing elements may be measured at all times. The friction loss shall be estimated as provided in the AASHTO Standard Specifications for Highway Bridges.

A record shall be kept of gage pressure and elongation at all times and submitted to the Chief Engineer for his approval.

- (D) **BONDING.** All prestressing reinforcement shall be bonded to the concrete and shall be free of dirt, loose rust, grease, or other deleterious substances. Before grouting, the ducts

shall be free of water, dirt or any other substance. The ducts shall be blown out with compressed air until no water or other substance comes through the duct. For long members with draped strands, an open tap at the low point of the duct may be necessary.

The annular space between the perimeter of the enclosure and the steel shall be pressure grouted after the prestressing process has been completed.

The grout shall be made to a consistency to permit adequate flow into the ducts. Proportions of the materials used to prepare the grout shall be based on tests made on the grout before operational grouting is begun, or may be selected based on prior documented experience with similar material and equipment under comparable field conditions. The water content shall be the minimum necessary for proper placement, and when Type I or Type II cement, as per 817, is used, shall not exceed a water-cement ratio of 0.45 or approximately 5 gallons of water per sack (94 lbs) of cement.

The pumpability of the grout may be determined by the Chief Engineer in accordance with the U.S. Corps of Engineers Method CRD-C611.80. When this method is used, the efflux time of the grout sample immediately after mixing shall not be less than 11 seconds.

Aluminum powder of the proper fineness and quantity may be used to obtain 5 to 10 percent unrestrained expansion of the grout.

During placement, grout shall be allowed to flow from the first vent after the inlet pipe until any residual flushing of water or entrapped air has been removed, at which time, the vent shall be capped or otherwise closed in sequence in the same manner.

The pumping pressure at the tendon outlet shall not exceed 250 psig.

If the actual grouting pressure exceeds the maximum recommended pumping pressure, grout may be injected at any vent which has been, or is ready to be, capped as long as a one-way flow of grout is maintained. If this procedure is used, then the vent which is to be used for injection shall be fitted with a positive shutoff.

When one-way flow of grout cannot be maintained, the grout shall be immediately flushed out of the duct with water.

Grout shall be pumped through the duct and continuously wasted at the outer pipe until no visible slugs of water or air are ejected and the efflux time of the ejected grout shall not be less than the injected grout. To insure that the tendon remains filled with grout, the outlet and/or inlet shall be closed. Plugs, caps or valves thus required shall not be removed or opened until the grout has set.

In temperatures below 32°F, ducts shall be kept free of water to avoid damage due to freezing.

The temperature of the concrete shall be 35°F or higher from the time of grouting until job cured 2 inch cubes of grout reach a minimum compressive strength of 800 psi.

Grout shall not be above 90°F during mixture or pumping. If necessary, the mixing water shall be cooled.

**705.07 TRANSPORTATION AND STORAGE**

Extreme care shall be exercised in handling and moving precast prestressed concrete members. Lifting hooks or other devices of approved design may be cast into the units. Precast girders and slabs shall be transported in an upright position and the points of support and directions of the reactions with respect to the member shall be approximately the same during transportation and storage as when the member is in its final position. If the Contractor deems it expedient to transport or store precast units in other than this position, it shall be done at his own risk and after notifying the Chief Engineer of his intention to do so.

Care shall be taken during storage, hoisting and handling of the precast units to prevent cracking or damage. Units damaged by improper storing or handling or in any other manner, shall be replaced by the Contractor at his expense.

**705.08 MEASURE AND PAYMENT**

The unit of measure for Prestressed Concrete Units will be each. The actual number of the several types and sizes of prestressed concrete units installed in place, completed and accepted, will be paid for at the contract unit price per each, which payment will include the concrete, reinforcing steel, prestressing reinforcement, enclosures for prestressing reinforcement, anchorages, plates, nuts, anchor dowels, bearing pad and plates, and other such material within or attached to the unit, including transverse diaphragms and transverse prestressing elements, and also, all labor, equipment, tools and incidentals necessary to complete the work as specified.

## 706 STRUCTURAL STEEL

### 706.01 DESCRIPTION

Work consists of furnishing all labor, materials, equipment, tools, and incidentals necessary to furnish, fabricate, store, assemble, shop paint, transport, erect, and place all structural steel, exclusive of bridge deck drainage and electrical conduit, pull boxes, etc., but including roadway and sidewalk joints, anchor bolts, castings, pins, rockers, shoes, alloy steels, weld metal, rivets, bolts, washers, nuts, bearing pads and other material, and also including all necessary galvanizing and the furnishing of notices, certificates, orders, statements, drawings and diagrams herein required.

Metal fabricators shall be certified in accordance with the AISC Quality Certification Program in Category I, II, or III, as appropriate. A copy of a valid certificate, along with the current annual endorsement, shall be submitted to the Chief Engineer before any metal fabricator will be approved to perform the work.

Anchor bolts shall be furnished as part of Structural Steel and set as part of the applicable PCC items.

Before submitting a proposal, the Contractor shall become familiar with all the local conditions affecting the erection work, confer with railroad officials for work within railroad rights-of-way, or other interested parties, as the case may be, and determine the method to be followed.

A copy of the current edition of the American Welding Society "Structural Welding Code Steel" (AASHTO/AWS D1.5M/1.5), a copy of the current edition of AASHTO "Standard Specifications for Welding of Structural Steel Highway Bridges," and a copy of the current edition of the American Institute of Steel Construction, Inc. "Manual of Steel Construction" shall be provided to the Chief Engineer, by the Contractor, prior to the start of any steel work.

### 706.02 MATERIALS

The materials shall be those which are specified on the plans and shall conform to the requirements of 815.01 and 822.02, and as specified herein. Requirements of AASHTO M 160 shall be met at all times. Failure to meet the requirements under this section will be cause for the rejection of the material. Galvanizing, when specified, shall meet the requirements of 811.07.

**(A) IDENTIFICATION OF STEELS DURING FABRICATION.** Each piece of steel to be fabricated shall be properly identified. Individual pieces furnished in tagged lifts or bundles shall be marked with the AASHTO M 160 color code immediately upon being removed from the bundle or lift. Pieces which prior to assembly will be subject to fabricating operations such as blast cleaning, galvanizing, heating for forming, or painting which might obliterate color code marking, shall be marked for grade by steel die stamping or by a substantial tag firmly attached. All die stamps used shall be of the low stress type. If during fabrication the original identifying number is hidden, cut off, or otherwise obliterated, the fabricator may, with the Chief Engineer's approval, repaint the number on the material at a conspicuous location.

- (B) **IDENTIFICATION BY CONTRACTOR.** The Contractor may furnish, from stock, material that he can identify by heat number and mill test report. Any excess material placed in stock for later use shall be marked with the mill test report number. Individually marked pieces of steel used in furnished size, or reduced from furnished size only by end or edge trim that does not disturb the heat number or color code or leave any usable piece may be used without further color coding provided the heat number or color code remains legible. Pieces to be cut to smaller size pieces shall be legibly marked with the AASHTO M 160 color code before cutting.
- (C) **THREADS FOR BOLTS AND PINS.** Threads for all bolts and pins for structural steel construction shall conform to United Standard Series UNC-ANSI B1.1, Class 2A for external threads and Class 2B for internal threads, except that the pin ends having a diameter of 1-3/8 inch or more shall be threaded 6 threads to the inch.

#### 706.03 WORKMANSHIP

- (A) **WORKMANSHIP AND FINISH.** Workmanship and finish shall be equal to the best general practice in modern bridge shops. All portions of the work shall be neatly finished. Shearing, flame cutting, and chipping shall be done neatly and accurately. Ends of all structural members shall be chipped after cutting to remove burrs.
- (B) **SEALANT.** Pockets or depressions which would hold water shall have efficient drain holes, or be sealed with polyurethane, or other approved sealant, conforming to FS TT-S-00230C, Type II, Class A, prior to painting. When the sealant is used in conjunction with weathering steel, the sealant shall be integrally pigmented to a dark bronze color.

#### 706.04 SHOP DRAWINGS

- (A) **GENERAL.** The Contractor shall prepare all shop drawings, erection diagrams, camber diagrams, and lists of bolts from general drawings of the structural steel as shown on the plans. All drawings shall be submitted in accordance with the requirements of 105.02. Unless otherwise specified herein, all detailing shall be in accordance with the requirements of the current AASHTO Standard Specifications for Highway Bridges. The Contractor shall compare and verify all dimensions shown before proceeding with the work. If any discrepancies or omissions are noticed, the Chief Engineer shall be immediately notified and a correction obtained. All layout measurements shall conform to the plans.
- (B) **IDENTIFICATION.** Shop drawings shall specifically identify each piece to be made of steel other than AASHTO M 183. Pieces made of different grades of steel shall not be given the same assembling or erecting mark, even though they are of identical dimensions and detail. The Contractor's system of assembly-marking individual pieces and the issuance of cutting instructions to the shop shall be such as to maintain identity of the mill test report number.

#### 706.05 INSPECTION

- (A) **GENERAL.** The Inspector shall have full access at all times to all parts of mills or shops where material to be inspected is being manufactured or fabricated.

The Inspector shall have the authority to reject any or all material or work which does not meet the requirements of the specifications. In case of dispute, the Contractor may appeal to the Chief Engineer, whose decision will be final.

The acceptance of any material or finished members by the Inspector will not bar their subsequent rejection, if found defective. Rejected material and workmanship shall be replaced and/or repaired to the satisfaction of the Chief Engineer.

- (B) **MILL INSPECTION.** The Contractor shall furnish the Chief Engineer, in duplicate, certified mill test reports and written certification that the material of each heat of steel meets the requirements.

Only material properly checked, sorted, and stored shall be used.

- (C) **SHOP INSPECTION.** Shop inspection will be performed by the District or an authorized agency of the District. The Chief Engineer shall be notified well in advance of the start of the work in the shop in order that arrangements may be made for shop inspection of material and workmanship. The fabricator shall furnish necessary facilities for inspection of workmanship and physical tests. The District must approve shop facilities to be used for fabrication prior to start of the fabrication process.

Only one reinspection for each instance of corrective action will be allowed at no cost to the Contractor. All costs associated with further re-inspections will be charged to the Contractor.

- (D) **NOTCH TOUGHNESS REQUIREMENTS.** Structural steel within the tension zone for members such as stringers, girder webs and flanges, including cross girder and bracket webs and flanges, girder splice plates and box column plates, conforming to AASHTO M270 Grade 50 and AASHTO M270 Grade 36, shall meet the longitudinal Charpy V-notch test specified in Table A below. Sampling and testing shall be in accordance with AASHTO T243(ASTM A 673-72). The (H) frequency of heat transfer shall be used.

**TABLE A**

<b>AASHTO Designation</b>	<b>Thickness In Inches</b>	<b>CVN In Foot Pounds</b>
M 270 Grade 36	ALL	15 @ 40 degrees F
M 270 Grade 50, 50W	Up to 4" mechanically fastened	15 @ 40 degrees F
	Up to 2" welded	15 @ 40 degrees F
	Over 2" welded	20 @ 40 degrees F
M 270 HPS Grade 70W	ALL	25 @ -10 degrees F
M 270 Grade 100, 100W	Up to 4" mechanically Fastened	25 @ 0 degrees F
	Up to 2 ½" welded	25 @ 0 degrees F
	Over 2 ½" welded	35 @ 0 degrees F

**706.06 SHOP STORAGE OF MATERIAL**

Structural material, either plain or fabricated, shall be stored at the bridge shop above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease, and other foreign matter, and shall be protected as far as practicable from corrosion.

**706.07 STRAIGHTENING MATERIAL**

Rolled material, before being laid off or worked, must be straight. If straightening is necessary, it shall be done by approved methods that will not injure the metal. Sharp kinks and bends shall be cause for rejection of the material.

Straightening main stress carrying members may only be done when permitted in writing by the Contracting Officer. When permitted by the Chief Engineer, straightening of shapes, plates, and built-up members which are not primary members, shall be done by methods that will not produce fracture or other structural defects. Distorted members shall be straightened by mechanical means or, if approved, by carefully planned and supervised application of a limited amount of localized heat. Heat shall not be applied directly on weld metal. The heat straightening of the AASHTO M 270 (ASTM A 709) Grades 70W, 100 and 100W steel members shall be done only under rigidly controlled procedures, with each application subject to the approval of the Chief Engineer. In no case shall the maximum temperature in degrees F exceed values in the following table.

Grade 70W > 6" from weld	1050°F
Grade 70W < 6" from weld	900°F
Grade 100 or 100W > 6" from weld	1100°F
Grade 100 or 100W < 6" from weld	950°F

In all other steels, the temperature of the heated area shall not exceed 1200°F (a dull red) nor 950°F at the weld metal and within 6 inches of weld metal, as controlled by temperature indicating crayons, liquids or bimetal thermometers. After heating, the metal shall be cooled as slowly as possible. Quenching is prohibited.

Parts to be heat straightened shall be substantially free from stress and from external forces, except stresses resulting from mechanical means used in conjunction with the application of heat.

Following the straightening of a bend or buckle, the surface of the metal will be inspected at Contractor's expense by methods as directed. Metal with evidence of fracture will be rejected.

**706.08 FLAME CUTTING**

Steel and weld metal shall be oxygen cut per AASHTO/AWS D1.5M/1.5:2002, as modified by the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges, provided a smooth and regular surface free from cracks and notches is secured, and provided an accurate profile from cracks and notches is secured, and provided an accurate profile is secured by use of a mechanical guide. Hand cutting shall be done only where approved.

Mill scale and extraneous material shall be removed from the torch side of ASTM A514/A517 steel plates along the lines to be flame cut, when necessary to obviate excessive notches.

### 706.09 BENT PLATES

Un-welded, cold-bent, load-carrying, rolled-steel plates shall conform to the following:

1. They shall be so taken from the stock plates that the bend line will be at right angles to the direction of rolling, except that cold-bent ribs for orthotropic deck bridges may be bent in the direction of rolling if permitted by the Chief Engineer.
2. Bending shall be such that no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are shown in the following table:

#### THICKNESS IN INCHES

	Up to 1/2	>1/2 to 1	>1 to 1-1/2	>1-1/2 to 2-1/2	>2-1/2 to 4
All grades of structural steel in this specification	2.5 t	2.5 t	3 t	3.5 t	4 t

Note: Low alloy steel in thicknesses over 1/2" may require hot bending for small radii.

Allowance for spring back of A514 and A517 steels should be about 3 times that for structural carbon steel. For brake press forming, the lower die span should be at least 16 times the plate thickness. Multiple hits are advisable.

If a shorter radius is essential, the plates shall be bent hot at a temperature not greater than 1200°F, except for A514/A517 steel. If A514/A517 steel plates to be bent are heated to a temperature greater than 1125°F, they must be re-quenched and tempered in accordance with the producing mill's practice. Hot bent plates shall conform to requirement 1, above.

3. Before bending, the corners of the plate shall be rounded to a radius of 1/16 inch throughout the portion of the plate at which the bending is to occur.

### 706.10 ANNEALING AND STRESS RELIEVING

Structural members to be annealed or normalized shall have finished machining, boring, and straightening done subsequent to heat treatment. Normalizing and full annealing shall be per AASHTO/AWS D1.5. The temperatures shall be maintained uniformly throughout the furnace during the heating and cooling so that the temperature at no two points on the member will differ by more than 100°F at any one time.

Members of A514/A517 steels shall not be annealed or normalized and shall be stress relieved only with the approval of the Chief Engineer.

Pieces in each furnace charge, temperatures and schedule used shall be recorded. Proper instruments including recording pyrometers shall be used to determine at any time the temperatures of members in the furnace. Treatment records shall be submitted on request. The holding temperature for stress relieving A514/A517 steel shall not exceed 1125°F.

Members, such as bridge shoes, pedestals and other parts which are built up by welding sections of plate together shall be stress relieved per AASHTO/AWS.

### 706.11 HOLES FOR BOLTS

This specification applies to bolt holes for bolted connections specified in 706.16 and 706.17.

- (A) **HOLES FOR HIGH STRENGTH AND UNFINISHED BOLTS.** All holes for bolts shall be either punched or drilled. Flame cutting is prohibited. Material forming parts of a member composed of not more than 5 thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of the bolts whenever the thickness of the material is not greater than 3/4 inch for structural steel, 5/8 inch for high-alloy steel, or 1/2 inch for quenched and tempered alloy steel, unless sub-punching and reaming are required. When there are more than 5 thicknesses or when any of the main material is thicker than 3/4 inch for structural steel, 5/8 inch for high strength steel, or 1/2 inch for quenched and tempered alloy steel, all holes shall either be sub-drilled or drilled full size.
- (B) **HOLES FOR RIBBED BOLTS, TURNED BOLTS OR OTHER APPROVED BEARING BOLTS.** All holes for ribbed bolts and other approved bearing-type bolts shall be sub-punched or sub-drilled 3/16 inch smaller than bolt nominal diameter and reamed assembled or to a steel template or, after assembly, drilled from the solid. In any case the finished holes shall provide a driving fit as specified.
- (C) **PUNCHED HOLES.** Die diameter shall not exceed the diameter of the punch by more than 1/16 inch. If any holes must be enlarged to admit bolts such holes shall be reamed. Holes shall be clean cut without torn or ragged edges. Poor matching of holes will be cause for rejection.
- (D) **REAMED OR DRILLED HOLES.** Reamed and drilled holes shall be cylindrical and perpendicular to the member. Where practicable, reamers shall be directed by mechanical means. Burrs on outside surfaces shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist drills. Assembled parts shall be taken apart for removal of burrs and shavings caused by drilling and reaming. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match marked before disassembly.
- (E) **PREPARATION OF FIELD CONNECTIONS.**
  - (1) **Sub-punching and Reaming of Field Connections.** Holes in all field connections and field splices shall be sub-punched or sub-drilled (sub-drilling if thickness limitations govern) 3/16 inch smaller as required and then reamed 1/16 inch larger while assembled or reamed to a steel template. All holes for floor beam and stringer field end connection holes through a steel template shall be done after the template has been located as to position and angle and firmly bolted in place. Templates used for reaming matching members, or the opposite faces of a single member, shall be exact duplicates. Templates used for connections on like parts or members shall be so accurately located that the parts or members are duplicates and require no match marking.
  - (2) **Numerically Controlled Drilled Field Connections.**

**(a) General.**

Alternately, for any connection or splice, in lieu of sub-sized holes and reaming while assembled, the Contractor shall have the option to drill bolt holes full-size in unassembled pieces and/or connections including templates for use with matching sub-sized and reamed holes by means of suitable numerically controlled (N/C) drilling equipment. If N/C drilling equipment is used, the Chief Engineer may require the Contractor, by means of check assemblies to demonstrate that this drilling procedure consistently produces holes and connections meeting the requirements of Subsections 706.11(F) and 706.14. The Contractor shall submit to the Chief Engineer for approval a detailed outline of the procedures that he proposes to follow in accomplishing the work from initial drilling through check assembly.

**(b) Holes.**

Holes drilled by N/C drilling equipment shall be drilled to appropriate size either through individual pieces, or any combination of pieces held tightly together.

- (F) ACCURACY OF REAMED AND DRILLED HOLES.** All holes punched full size, sub-punched or sub-drilled shall be accurately punched so that after assembly and before reaming, a cylindrical pin 1/8 inch smaller in diameter than the punched hole nominal size may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. Members with holes failing to meet this requirement will be rejected. Members shall be rejected with a hole through which a pin, 3/16 inch smaller in diameter than punched hole nominal size will not pass. When holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 inch between adjacent thicknesses of metal. All steel templates shall have hardened steel bushings in holes accurately dimensioned from the center lines of the connection as inscribed on the templates. The center lines shall be used in locating accurately the template from the milled or scribed ends of the members.

**706.12 FINISHING AND FITTING**

- (A) GENERAL.** Finished members shall be true to line and free from twists, bends and open joints.
- (B) EDGE PLANING.** Sheared edges of plates more than 5/8 inch thickness and carrying calculated stress shall be planed to a depth of 1/4 inch. Re-entrant corners shall be filleted to a radius of 3/4 inch before cutting.
- (C) FACING OF BEARING SURFACES.** The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with PCC shall meet the ANSI surface roughness requirements as defined in ANSI B46.1, Surface Roughness, Waviness and Lay, Part I:

**Bearing Surfaces****ANSI Finish**

Heavy plates in contact in shoes to be welded

1,000

- |  |     |
|--|-----|
| Milled ends of compression members, stiffeners and fillers | 500 |
| Bridge rollers and rockers                                 | 250 |
| Pins and pin holes   | 125 |
| Sliding bearings   | 125 |
- (D) **ABUTTING JOINTS.** Abutting joints in compression members and girder flanges, and in tension members where so specified on the drawings, shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 1/4 inch.
- (E) **FABRICATION OF MEMBERS.** Unless otherwise shown on the plans, steel plates for main members, not secondary members, shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses.
- (F) **END CONNECTION ANGLES.** Floor beams, stringers, and girders having end connection angles shall be built to exact length shown on the plans measured between heels of the connection angles, with a permissible tolerance of plus 0 inch to minus 1/16 inch. Where continuity is to be required, end connections shall be faced. The thickness of the connection angles shall not be less than 3/8 inch nor less than that shown on the detail drawings, after facing.
- (G) **LACING BARS.** The end of lacing bars shall be neatly rounded unless another form is specified.
- (H) **WEB PLATES.** At web splices, the clearance between the ends of the web plates shall not exceed 3/8 inch. The clearances at the top and bottom ends of the web slice plates shall not exceed 1/4 inch.
- (I) **FIT OF STIFFENERS.** Unless otherwise shown on the plans, end stiffeners of girders and stiffeners intended as supports for concentrated loads shall be milled or ground to secure an even bearing against the flanges. Intermediate stiffeners shall fit sufficiently tight to exclude water after being painted. Fillers under stiffeners shall fit within 1/4 inch at each end.

Welding will be permitted in lieu of milling or grinding if noted on the plans. Welding on the tension flanges of beams and girders will not be permitted unless shown on the plans.

### 706.13 CAMBER

When specified cambers for rolled beams are shown on the plans, the beams shall be cambered in the rolling mill, either while hot or else in the straightening gag after cooling. Cambers for rolled beams shall conform to standard mill practices as specified by AISC. During mill operations and fabrication of splices, beams shall be so supported that the camber is maintained. When camber is not specified, rolled beams shall be fabricated with standard mill camber with convex flange up. All built-up main girders and other members shall be cambered as nearly as practicable to conform to the dead load deflection shown on the plans. Camber diagrams showing the cambers required for the dead load deflections shown on the

plans shall be submitted for approval. A tolerance of plus 1/2 inch to minus 0 inch will be allowed.

#### 706.14 SHOP ASSEMBLING

The field connections of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders, and rigid frames shall be assembled in the shop with milled ends of compression members in full bearing, and then shall have their sub-size holes reamed to specified size while the connections are assembled. Assembly shall be Full Truss or Girder Assembly, unless a Progressive Truss or Girder Assembly, Full Chord Assembly, Progressive Chord Assembly, or Special Complete Structure Assembly is specified in the special provisions.

Each assembly, including camber, alignment, accuracy of holes, and fit of milled joints, shall be approved by the Chief Engineer before reaming is commenced. A camber diagram shall be furnished the Chief Engineer by the Fabricator showing the camber of each panel point of each truss, arch rib, continuous beam line, plate girder or rigid frame. When the shop assembly is Full Truss or Girder Assembly or Special Complete Structure Assembly, the camber diagram shall show the camber measured in assembly. When any of the other methods of shop assembly is used, the camber diagram shall show calculated camber. Surfaces of metal in contact shall be cleaned before assembling. The parts of a member shall be assembled, well pinned, and firmly drawn together with bolts before reaming is commenced. Assembled pieces shall be taken apart, if necessary, for the removal of burrs and shavings produced by the reaming operation. The member shall be free from twists, bends, and other deformations.

Preparatory to the shop bolting of full-sized punched material, the holes, if necessary, shall be spear-reamed for the admission of the bolts. The reamed holes shall not be more than 1/16 inch larger than the nominal diameter of the bolts. End connection angles, stiffener angles, and similar parts shall be carefully adjusted to correct positions and bolted, clamped, or otherwise firmly held in place until bolted. Parts not completely bolted in the shop shall be secured by bolts, insofar as practicable, to prevent damage in shipment and handling.

- (A) **FULL TRUSS OR GIRDER ASSEMBLY.** Full Truss or Girder Assembly shall consist of assembling all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder, or rigid frame at one time.
- (B) **PROGRESSIVE TRUSS OR GIRDER ASSEMBLY.** Progressive Truss or Girder Assembly shall consist of assembling initially for each truss, arch rib, bent, tower face, continuous beam line, plate girder, or rigid frame at least three contiguous shop sections or all members in at least three contiguous panels but not less than the number of panels associated with three contiguous chord lengths (i.e., length between field splices) and not less than 150 feet in the case of structures longer than 150 feet. At least one shop section or panel or as many panels as are associated with a chord length shall be added at the advancing end of the assembly before any member is removed from the rearward end, so that the assembled portion of the structure is never less than that specified above.
- (C) **FULL CHORD ASSEMBLY.** Full Chord Assembly shall consist of assembling, with geometric angles at the joints, the full length of each chord of each truss or open spandrel arch, or each leg of each bent or tower, then reaming their field connection holes while

the members are assembled and reaming the web member connections to steel templates set at geometric (not cambered) angular relation to the chord lines.

Field connection holes in web members shall be reamed to steel templates. At least one end of each web member shall be milled or shall be scribed normal to the longitudinal axis of the member and the templates at both ends of the member shall be accurately located from one of the milled ends or scribed lines.

- (D) **PROGRESSIVE CHORD ASSEMBLY.** Progressive Chord Assembly shall consist of assembling contiguous chord members in the manner specified for Full Chord Assembly and in the number and length specified for Progressive Truss or Girder Assembly.
- (E) **SPECIAL COMPLETE STRUCTURE ASSEMBLY.** Special Complete Structure Assembly shall consist of assembling the entire structure, including the floor system. (This procedure is ordinarily needed only for complicated structures such as those having curved girders, or extreme skew in combination with severe grade or camber.)
- (F) **DRIFTING OF HOLES.** The drifting done during assembling shall be only such as to bring the parts into position, and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the bolts, they shall be reamed.
- (G) **MATCH-MARKING.** Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be match-marked, and a diagram showing such marks shall be furnished to the Chief Engineer.

#### 706.15 PINS AND ROLLERS

- (A) **GENERAL.** Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth, and free from flaws. Pins and rollers more than 9 inches in diameter shall be forged and annealed. Pins and rollers 9 inches or less in diameter may be either forged and annealed or cold-finish carbon-steel shafting.

In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis after the forging has been allowed to cool to a temperature below the critical range, under suitable conditions to prevent injury by too rapid cooling, and before being annealed.

- (B) **BORING PIN HOLES.** Pin holes shall be bored true to the specified diameter, smooth, and straight, at right angles with the axis of the member, and parallel with each other unless otherwise specified. The final surface shall be produced by a finishing cut. The distance outside to outside of holes in tension members and inside to inside of holes in compression members shall not vary more than 1/32 inch from that specified. Boring of holes in built-up members shall be done after assembly is completed. The diameter of the pin hole shall not exceed that of the pin by more than 1/50 inch for pins 5 inches in diameter, or 1/32 inch for larger pins.
- (C) **PIN CLEARANCES.** Two pilot nuts and two driving nuts for each size of pin shall be furnished for use in driving pins. Pins shall be so driven that the members will take full bearing on them. Pin nuts shall be drawn up right and the threads burred at the face of the nut with a pointed tool.

**706.16 BOLTS AND BOLTED CONNECTIONS**

The specifications of this article do not pertain to the use of high strength bolts. Connections fabricated with high strength bolts shall conform to 706.17.

- (A) **GENERAL.** Bolts shall be unfinished, turned, or ribbed bolts per ASTM A 307, Grade A. Bolted connections shall be used only as indicated. Bolts shall have single self-locking nuts or double nuts. Beveled washers shall be used where bearing faces have a slope of more than 1/20 with respect to a plane normal to bolt axis.
- (B) **UNFINISHED BOLTS.** Unfinished bolts shall be furnished unless other types are specified.
- (C) **TURNED BOLTS.** The surface of the body of turned bolts shall meet ANSI 125 finish. Heads and nuts shall be hexagonal with standard dimensions for bolts of the nominal size specified or the next larger nominal size. Diameter of threads shall be equal to the body of the bolt or the nominal diameter of the bolt specified. Holes for turned bolts shall be carefully reamed with bolts furnished to provide a light driving fit. Threads shall be entirely outside of the holes. A washer shall be provided under the nut.
- (D) **RIBBED BOLTS.** The body of ribbed bolts shall be of an approved form with continuous longitudinal ribs. The diameter of the body measured on a circle through the points of the ribs shall be 5/64 inch greater than the nominal diameter specified for the bolts. Ribbed bolts shall be furnished with round heads per ANSI B 18.5. Nuts shall be hexagonal, either recessed or with a washer of suitable thickness. Ribbed bolts shall make a driving fit with the holes. The hardness of the ribs shall be such that the ribs do not mash down enough to permit the bolts to turn in the holes during tightening. If for any reason the bolt twists before drawing tight, the hole shall be carefully reamed and an oversized bolt used as a replacement.

**706.17 HIGH-STRENGTH STEEL BOLT CONNECTIONS**

- (A) **GENERAL** - This specification applies to all structural steel connections using AASHTO M164 (ASTM A325) or AASHTO M253 (ASTM A490) high strength bolts.
  - (1) All high strength bolts, nuts and washers shall be furnished in accordance with the appropriate AASHTO materials specifications as amended and revised herein.
  - (2) Additional requirements for field or shop installation of high strength bolts are also included. These additional requirements supplement AASHTO Division II, Section 11.
- (B) **SPECIFICATIONS** - All hardware covered by this specification shall meet the following requirements:
  - (1) All bolts shall meet the requirements of AASHTO M164 (ASTM A 325) or AASHTO M253 (ASTM A490) and these revisions.
  - (2) All nuts shall meet the requirements of AASHTO M292 (ASTM A194), as applicable or AASHTO M291 (ASTM A563) and these revisions.
  - (3) All washers shall meet the requirements of AASHTO M293 (ASTM F436), as applicable or ASTM F 959 and these revisions.

**(C) MANUFACTURING -****(1) Bolts:**

The hardness for bolt diameters 1/2 inch to 1 inch inclusive shall be as noted below:

Bolt Size	Hardness Number			
	Brinell		Rockwell C	
	Min	Max	Min	Max
1/2 to 1 inch	248	311	24	33

**(2) Nuts:**

- (a) Nuts to be galvanized shall be heat treated grade 2H, DH, or DH3.
  - (b) Plain (un-galvanized) nuts shall be grades 2, C, D or C3 with a minimum Rockwell hardness of 89 HRB (or Brinell hardness 180 HB), or heat treated grades 2H, DH or DH3. (The hardness requirements for grades 2, C, D and C3 exceed the current AASHTO/ASTM requirements).
  - (c) Nuts that are to be galvanized shall be tapped oversize the minimum amount required for proper assembly. The amount of over-tap in the nut shall be such that the nut will assemble freely on the bolt in the coated condition and shall meet the mechanical requirements of AASHTO M291 (ASTM A 563) and the rotational capacity test herein (the overtapping requirements of AASHTO M291 [ASTM A 563], paragraph 7.4 shall be considered maximum values instead of minimum, as currently shown).
  - (d) Galvanized nuts shall be lubricated with a lubricant containing a dye of any color that contrasts with the color of the galvanizing.
- (3) Marking** - All bolts, nuts and washers shall be marked in accordance with the appropriate AASHTO/ASTM Specifications.
- (4) Galvanizing** - ASTM 490 bolts, nuts and washers shall be plain (uncoated) and ASTM 325 Type 1 bolts, nuts and washers shall be mechanically galvanized in accordance with AASHTO M298 (ASTM B695) Class 50. High strength bolts used with unpainted weathering steel shall conform to ASTM A325, Type 3 or when specified, ASTM A490, Type 3.

**(D) TESTING****(1) Bolts:**

- (a) Proof load tests (ASTM F 606 Method 1) are required. The minimum frequency of tests shall be as specified in AASHTO M164 (ASTM A 325) and AASHTO M253 (ASTM A490).
- (b) Wedge tests on full size bolts (ASTM F 606, paragraph 3.5) are required. If bolts are to be galvanized, tests shall be performed after galvanizing. The

minimum frequency of tests shall be as specified in AASHTO M164 (ASTM A 325) and AASHTO M253 (ASTM A490).

- (c) If galvanized bolts are supplied, the thickness of the zinc coating shall be measured. Measurements shall be taken on the wrench flats or top of bolt head.

**(2) Nuts:**

- (a) Proof load tests (ASTM F 606, paragraph 4.2) are required. The minimum frequency of tests shall be as specified in AASHTO M291 (ASTM A 563), paragraph 9.3 or AASHTO M292 (ASTM A 194), paragraph 7.1.2.1. If nuts are to be galvanized, tests shall be performed after galvanizing, over-tapping and lubricating.
- (b) If galvanized nuts are supplied, the thickness of the zinc coating shall be measured. Measurements shall be taken on the wrench flats.

**(3) Washers:**

- (a) If galvanized washers are supplied, hardness testing shall be performed after galvanizing. (The coating shall be removed prior to taking hardness measurements).
- (b) If galvanized washers are supplied, the thickness of the zinc coating shall be measured.

**(4) Assemblies:**

Rotational capacity tests are required and shall be performed on all black or galvanized (after galvanizing) bolt, nut and washer assemblies by the manufacturer or distributor prior to shipping. The use of washers is required as part of the test even though they may not be required as part of the installation procedure.

The following shall apply:

- (a) Except as modified herein, the rotational capacity test shall be performed in accordance with the requirements of AASHTO M164 (ASTM A 325).
- (b) Each combination of bolt production lot, nut lot and washer lot shall be tested as an assembly. Where washers are not required by the installation procedures, they need not be included in the lot identification.
- (c) A rotational capacity lot identification number shall be assigned to each combination of lots tested.
- (d) The minimum frequency of testing shall be two assemblies per rotational capacity lot.
- (e) The bolt, nut and washer assembly shall be assembled in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device (note - this requirement supersedes the current AASHTO M164 [ASTM A 325] requirement that the test be performed in a steel joint). For bolts which are too short to be assembled in the Skidmore-Wilhelm Calibrator, see Section C.4.i.

- (f) The minimum rotation, from a snug tight condition (10% of the specified proof load), shall be:

240 degrees (2/3 turn) for bolt lengths less than or equal to 4 diameters

360 degrees (1 turn) for bolt lengths greater than 4 diameters to less than or equal to 8 diameters

480 degrees (1 1/3 turn) for bolt lengths greater than 8 diameters

(Note: These values differ from the AASHTO M164 Table 8/ ASTM A 325 Table 6 Specifications).

- (g) The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension. The installation tension and the tension for the turn test are shown below:

Diameter (inches)	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Required Installation Tension (kips)	12	19	28	39	51	56	71	85	103
Turn Test Tension (kips)	14	22	32	45	59	64	82	98	118

- (h) After the required installation tension listed above has been exceeded, one reading of tension and torque shall be taken and recorded. The torque value shall conform to the following:

Torque is less than or equal to 0.25 PD where:

Torque = measured torque (foot-pounds)

P = measured bolt tension (pounds)

D = bolt diameter (feet)

- (i) Bolts that are too short to test in a Skidmore-Wilhelm Calibrator may be tested in a steel joint. The tension requirement of Section D.4.g. shall be computed using a value of P equal to the turn test tension shown in the table in Section D.4.g.

**(5) Reporting:**

- (a) The results of all tests (including zinc coating thickness) required herein and in the appropriate AASHTO specifications shall be recorded on the appropriate document.
- (b) The location where tests are performed and the date of the tests shall be reported on the appropriate document.

**(6) Witnessing:**

The tests need not be witnessed by an inspection agency; however, the manufacturer or distributor that performs the tests shall certify that the results recorded are accurate.

**(E) DOCUMENTATION****(1) Mill Test Report(s) (MTR):**

(a) MTR shall be furnished for all mill steel used in the manufacture of the bolts, nuts and washers.

(b) MTR shall indicate the place where the material was melted and manufactured.

**(2) Manufacturer Certified Test Report(s) (MCTR):**

(a) The manufacturer of the bolts, nuts and washers shall furnish test reports (MCTR) for the item furnished.

(b) Each MCTR shall show the relevant information required in accordance with Section D.5.

(c) The manufacturer performing the rotational capacity test shall include in the MCTR:

(1) The lot number of each of the items tested.

(2) The rotational capacity lot number as required in Section D.4.

(3) The results of the tests required in Section D.4.

(4) The pertinent information required in D.5.a.

(5) A statement that MCTR for the items are in conformance with this specification and the appropriate AASHTO specifications.

(6) The location where the bolt assembly components were manufactured.

**(3) Distributor Certified Test Report(s) (DCTR):**

(a) The DCTR shall include MCTR above for the various bolt assembly components.

(b) The rotational capacity test may be performed by a distributor (in lieu of a manufacturer) and reported in the DCTR.

(c) The DCTR shall show the results of the tests required in Section D.4.

(d) The DCTR shall also show the pertinent information required in Section D.5.b.

(e) The DCTR shall show the rotational capacity lot number as required in Section D.4.c.

(f) The DCTR shall certify that the MCTR are in conformance with this specification and the appropriate AASHTO specification.

**(F) SHIPPING:**

- (1) Bolts, nuts and washers (where required) from each rotational capacity lot shall be shipped in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. Each container shall be permanently marked with the rotational capacity lot number such that identification will be possible at any stage prior to installation.
- (2) The appropriate MTR, MCTR or DCTR shall be supplied to the Contractor or Owner as required by the Contract Documents.

**(G) INSTALLATION:**

The following requirements for installation apply in addition to the specifications in AASHTO Division II, Section 11 when high strength bolts are installed in the field or shop.

- (1) Bolts shall be installed in accordance with AASHTO Division II, Article 11.5.6. During installation, regardless of the tightening method used, particular care should be exercised so that the snug tight condition as defined in Article 11.5.6 is achieved.
- (2) The rotational capacity test described in Section D.4. above shall be performed on each rotational capacity lot prior to the start of bolt installation. Hardened steel washers are required as part of the test although they may not be required in the actual installation procedures.
- (3) A Skidmore-Wilhelm Calibrator or an acceptable equivalent tension measuring device shall be required at each job site during erection. Periodic testing (at least one each working day when the calibrated wrench method is used) shall be performed to assure compliance with the installation test procedures required in AASHTO Division II, Article 11.5.6.4 for Turn-of-Nut Tightening, Calibrated Wrench Tightening, Installation of Alternate Design Bolts and Direct Tension Indicator Tightening. Bolts that are too short for the Skidmore-Wilhelm Calibrator may be tested using direct tension indicators (DTIs). The DTIs must be calibrated in the Skidmore-Wilhelm Calibrator using longer bolts. The tests shall be performed by the Contractor and witnessed by the Chief Engineer.
- (4) Lubrication
  - (a) Galvanized nuts shall be checked to verify that a visible lubricant is on the threads.
  - (b) Black bolts shall be “oily” to the touch when delivered and installed.
  - (c) Weathered or rusted bolts or nuts not satisfying the requirements of (a) or (b) above shall be cleaned and re-lubricated prior to installation. Re-cleaned or re-lubricated bolt, nut and washer assemblies shall be retested in accordance with (b) above prior to installation.
- (5) Bolt, nut and washer (when required) combinations as installed shall be from the same rotational capacity lot.

**(H) CONDITION OF BOLTED PARTS.**

- (1) Slope and Fit. The slope of surfaces of bolted parts in contact with the bolt head and nut shall not exceed 1:20 with respect to a plane normal to bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material.
- (2) Contact Surfaces. When assembled, all joint and bolt assembly surfaces shall be free of scale, except tight mill scale, and shall also be free of dirt, burrs, foreign material, and other defects that may prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, and rust inhibitor. Galvanized surfaces shall be wire-brushed or brush-off blasted.

**(I) BOLT INSPECTION.** The Contractor shall furnish all labor, materials, equipment, and rigging and perform shop and field bolted connection inspection in a safe and convenient manner. The inspection shall be witnessed by the Chief Engineer. Regardless of the method of bolt installation, bolts in each connection shall be inspected as specified under this sub-section.

- (1) Wrench. The Contractor shall furnish for the Chief Engineer's use dependable and approved hand torque wrenches and/or torque multiplier wrenches that can be accurately adjusted to specified limits, and bolt tension calibrators as required. Pneumatic wrenches are prohibited for bolt inspection and testing. Wrench calibration certification, by an approved agency equipped to perform torque wrench testing, shall accompany the wrenches and shall include identity of wrenches and date of calibration.
- (2) Inspection Procedure.
  - (a) To determine job inspection torque, 3 test bolts of the same grade, size and condition as those under inspection shall be placed individually in a calibration device furnished by the Contractor and capable of indicating required bolt tension. There shall be a washer under the part turned in tightening each bolt.
  - (b) The job inspecting torque shall be determined by a torque wrench. Each test bolt specified shall be tightened in the calibration device by any convenient means to the minimum required tension. The torque wrench then shall be applied to the tightened bolt and the torque necessary to turn the nut or head 5 degrees (approximately 1 inch at 12 inch radius) in tightening direction shall be determined. The average torque measured in the test of 3 bolts shall be taken as the job inspecting torque to be used for bolts under inspection.
  - (c) The wrench and its job inspecting torque then shall be applied to 15 percent of the bolts, but no less than 3 bolts, selected at random in each connection, whether tightened by wrench or turn of nut method. If no nut or bolt head is turned by application of the job inspecting torque, the connection shall be accepted as properly tightened. If any nut or bolt head is turned by application of the job inspecting torque, the Contractor shall have this torque applied to all bolts in the connection, and all bolts whose nut or head is turned by the job inspecting torque shall be tightened and re-inspected.

- (d) When a bolt is properly tightened in place, at least 3 but not more than 5 threads shall be visible above the nut.

#### **706.18 WELDING**

- (A) **GENERAL.** Structures shall be welded in accordance with the Plans, Special Provisions, and the current edition of AASHTO “Standard Specifications for Welding of Structural Steel Highway Bridges” and the edition of the American Welding Society “Structural Welding Code AASHTO/AWS D1.5M/1.5:2002”.
- (B) **QUALIFICATIONS OF PROCEDURES.** Pre-qualified welding procedures and welding procedures to be qualified shall be submitted to the Chief Engineer for approval using the forms shown in AWS D1.1, Appendix E. No welding shall be done prior to the Chief Engineer’s approval of the welding procedures. No unspecified temporary or permanent weld shall be made without specific written approval.
- (C) **QUALIFICATION OF WELDERS.** Properly documented evidence of successful completion of qualification tests under the supervision of an approved testing agency and as prescribed in AASHTO shall be submitted for all welders, welding operators, and tackers. Approval by the Chief Engineer shall be obtained prior to any welding. Qualified welders shall be retested if they have not practiced welding for six months preceding the start of welding work. Evidence of such welding practice shall be satisfactory to the Chief Engineer.
- (D) **WORKMANSHIP AND TECHNIQUE.**
  - (1) Electrodes. Electrodes per AWS, A5.5, shall be dried 1 hour plus or minus 15 minutes before being used. If flux is used from an opened package or dispensing system inoperative for 4 hours or more, the top 1 inch shall be discarded. The first weld pass shall be given special attention to ensure proper fusion and penetration of the base metal at root of joint.
  - (2) Tolerance. In addition to AWS D1.5, Section 3.5, Dimensional Tolerances, the combined warpage and tilt offset of flanges of welded box girders shall not exceed 1/100 of flange width between two adjacent webs, or 1/4 inch, whichever is greater.
  - (3) Deficient Welds. Additional work and revised approved design required due to correction of deficient welds shall be at the Contractor expense.
  - (4) Peening. Peening, when approved, shall be done preferably while the weld is hot and with a hand or pneumatic tool whose point or edge is rounded sufficiently to avoid damage to weld metal.
  - (5) Electroslag. Electroslag welding is prohibited.
  - (6) Electrogas. However, electrogas requirements under AWS D1.1, Appendix C, apply. When evidence of record is accepted in lieu of required tests for electrogas weld metal properties, the Contractor shall furnish the manufacturer’s certification that the filler metal and shielding being used on the project were manufactured with the same material and process requirements as the filler and shielding used for the evidence of record procedure.

- (E) **WELDING INSPECTION.** The Contractor shall furnish proper equipment and qualified personnel to make radiographic, ultrasonic, magnetic particle and other tests of shop and field welds.
- (1) Personnel. Personnel performing non-destructive tests shall be qualified per the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A. Only persons qualified for NDT LEVEL I and supervised by a person qualified for NDT LEVEL II, or persons qualified for NDT LEVELS II or III may perform nondestructive tests. Prequalification certification shall be furnished on request.
  - (2) Inspection Acceptance. Radiographs, ultrasonic and magnetic particle tests shall be made only in the presence of the Inspector. Test results shall be approved before members will be accepted.
  - (3) Inspection Timing. Inspection of welds in all steel shall begin after the welds have reached ambient temperature, except welds in A514/A517 steels which shall be inspected not less than 48 hours after they are completed. However, at junctions of intersecting welds subject to nondestructive tests, inspection and test shall be conducted after welded junction is complete.
  - (4) Cracks. In addition to inspection per AASHTO and criteria listed below under Radiographic and Magnetic Particle Tests, all welds shall be visually inspected for cracks. Procedures, techniques and standards of acceptance shall be per AASHTO.
  - (5) Reports. All radiographs, ultrasonic test reports, and magnetic particle test reports, including those of defective welds, shall become District property.
- (F) **RADIOGRAPHY AND ULTRASONIC TESTS.** The following groove welds forming butt, tee, or corner joints on girders, beams, stringers, brackets, truss members or the members shall be examined in accordance with AASHTO by the radiographic or ultrasonic method as determined by the Chief Engineer. The weld thickness shall be a minimum of 1/2 inch for ultrasonic testing.
- (1) 100 percent of all shop welded flanges and flange splices plus 25 percent of all shop welded web splices adjacent to the top flange and 25 percent adjacent to the bottom flange.
  - (2) 100 percent of all shop splice welds when more than 10 percent of radiographs or ultrasonic tests indicate rejectable defects until accumulated rejection level falls to 10 percent or less, then the original percent level specified above shall again govern.
  - (3) 100 percent of all field welded flange splices except box girder longitudinal flange seam splices.
  - (4) 100 percent of all field welded web splices.
- (G) **MAGNETIC PARTICLE TESTS.** The following shop and field fillet welds shall be examined by the magnetic particle method per ASTM E 109.
- (1) At least 1 foot of every 10 feet of weld and 1 foot of each weld less than 10 feet of each size weld. Test shall be located at random so as to be typical for each size weld.
  - (2) The full length of the weld, or 5 feet on one side of the test length, whichever is less, when test indicates a rejectable defect in any test length of weld.

- (3) Areas on each side of a rejectable defect to determine extent of defect.
  - (4) 100 percent of repaired welds for welds found defective by magnetic particle tests.
- (H) **DYE PENETRANT TESTS.** In field welded girder and beam groove weld splices without the aid of backing, the joint shall be chipped, gouged or ground to sound metal on the root side after sufficient welding has been done on one side, and the root areas then examined by the dye penetrant method per ASTM E 165. Edges of flange butt welds shall be examined by the dye penetrant method. The dye penetrant method may be substituted for magnetic particle testing for shop welds only.

#### 706.19 SHEAR DEVICES

- (A) **Shear Studs.** Studs for shear devices shall conform to the requirements for the respective materials as provided in 815.01(F). They shall be attached to the beams as shown on the plans. Welding shall conform to the requirements outlined herein. Special patented devices, and connections therefore, if specified, shall be constructed according to the manufacturer's recommended practice or as shown on the plans.
- (B) **Procedure.** Stud welding shall conform to the requirements of AASHTO and the following:
1. Before any stud welding operation is begun, or after the welding equipment has remained idle for 1 hour, trial studs shall be welded to a structural steel plate for testing. After being welded to the plate and the weld has cooled, each stud will be bent down to the plate by striking with a hammer. This test will be continued until there is no failure of trial stud.
  2. Longitudinal and lateral spacing of stud shear connectors with respect to each other and to edges of beam or girder flanges may vary a maximum of 1 inch from the location shown on the drawings, provided the adjacent studs are not closer than 2-1/2 inches center to center. The minimum distance from the edge of a stud base to the edge of a flange shall be the diameter of the stud plus 1/8 inch, but preferably not less than 1-1/2 inch. The accuracy of location of other types of studs shall be such as to permit a workmanlike assembly of attachments without alterations or reaming.
  3. All structural steel in a particular span of a bridge must be erected and have deck forming complete in place before shear devices are attached in that span.
  4. After stud welding is completed, a visual inspection of the studs and welding will be made by the Chief Engineer for approval prior to placing of the concrete slab.
  5. If during the progress of the work, testing and inspection indicate, in the sole judgment of the Chief Engineer, that the type of studs, equipment, etc., being furnished are not in accordance with AWS requirements, the Contractor will be required to change equipment and/or change to another type of stud or shear developer at no additional cost to the District.

#### 706.20 PAINTING

Structural steel shall be shop painted in conformance with the requirements of 707.

**706.21 MARKING AND SHIPPING**

- (A) **Erection Marks.** Each member shall be painted or marked with an erection mark for identification and erection diagrams shall be furnished with erection marks thereon, as outlined in 105.02.
- (B) **Shipping.** The Contractor shall furnish the Chief Engineer with 2 copies of shipping statements. The weights of the individual members shall be shown on the statements. Members weighing more than 5 tons shall have the weight marked thereon. Bolts of one length and diameter and loose nuts or washers of each size shall be packed separately. Pins, small parts and packages of bolts, washers, and nuts shall be shipped in boxes, crates kegs, or barrels, but the gross weight of any package shall not exceed 300 pounds. A list and description of the contained material shall be plainly marked on the outside of each package.
- (C) **Storage.** Material to be stored shall be placed on skids above the ground. Storage should be under shelter if possible but in any event members shall be placed where least likely to be marred or subject to contamination of any sort. Members shall be stored so as to avoid formation of water-holding pockets and kept properly drained. If storage is outdoors for several months, the shop coat shall be inspected periodically for integrity and any chalking surfaces cleaned and repainted with a shop coat. Girders and beams shall be placed upright and shored. Long members shall be supported on skids placed near enough together to prevent injury from deflection.
- (D) **Damage.** The loading, transportation, unloading, and field storage of fabricated and rolled material shall be conducted so as to avoid injury and deformation of the metal. The Contractor shall make the necessary arrangements for the transportation, unloading and hauling of the steel to the point of placement. The Contractor shall be responsible for the loss and/or damage of any material delivered and/or stored for the work under contract. Damaged material shall be repaired or replaced by the Contractor at his sole expense.

**706.22 BEARINGS AND ANCHORAGE**

- (A) **Bearing Areas.** Masonry bearing plates, shoes and pedestals shall not be placed upon bridge seat bearing areas which are improperly finished, deformed or irregular. Unless otherwise specified on the plans, or directed by the Chief Engineer, bearing plates, shoes and pedestals shall be set by one of the methods outlined in 703.20. Bridge bearings shall be set level, in exact position and shall have full and even bearing on the masonry. Care shall be taken that full, free movement of the superstructure at the movable bearings is not restricted by improper setting or adjustment of bearings or anchor bolts and nuts.

**706.23 ERECTION**

- (A) **METHODS AND EQUIPMENT.** Before start of erection, the Contractor shall submit for approval all necessary erection diagrams, the amount and type of erection equipment he proposes and other details as requested. The approval of the Chief Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his method or equipment or from carrying out the work in full accordance with the plans and specifications. No work shall be done until such approval by the Chief Engineer has been obtained.

- (B) **FALSEWORK.** All work for falsework design, submittals of design calculations and working and erection drawings for falsework and construction and maintenance of falsework shall be performed in accordance with the requirements of 703.16. These requirements also apply when it is necessary to make changes to an existing structure for maintaining traffic. Approval of the Contractor's plans shall not be considered as relieving the Contractor of any responsibility.
- (C) **ASSEMBLING STEEL.** The parts shall be accurately assembled as shown on the plans and any match marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken, or otherwise damaged. Hammering which will injure or distort the members will not be permitted. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled.
- (1) **Grade and Alignment.** Before start of field bolting or welding, the structure shall be adjusted to correct grade and alignment and the elevations of panel points and other points as needed adjusted. Re-bolting and re-welding due to incomplete and incorrect structure adjustments beforehand shall be at Contractor expense.
  - (2) **Bolted Connections.** After hoisting steel members into position and prior to releasing weight to the member or releasing hoisting devices, each field bolted connection shall have 25 percent of the holes filled with erection bolts and 25 percent with cylindrical erection pins before high strength bolting. Each field bolted connection carrying superimposed loads during erection shall have 38 percent of the holes filled with bolts and 38 percent with pins before high strength bolting.
  - (3) **Fitting-Up Bolts and Erection Pins.** Fitting-up bolts shall be the same diameter as high strength bolts, and cylindrical erection pins shall be 1/32 inch larger.
- (D) **MISFITS.** The correction of minor misfits involving non-harmful amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Chief Engineer and his approval of the method of correction obtained. The Contractor shall be responsible for all misfits, errors, and injuries, and shall make the necessary corrections and/or replacements.
- (E) **REMOVAL OF FALSEWORK AND CLEANUP.** Upon completion of the erection and before final acceptance the Contractor shall remove all falsework, excavated or useless materials, rubbish and temporary buildings, replace or renew any fences damaged and restore in an acceptable manner all property, both public and private, which may have been damaged during the prosecution of this work, and shall leave the bridge site and adjacent highway or street in a neat and presentable condition satisfactory to the Chief Engineer. All excavated material or falsework placed in the stream channel during construction shall be removed by the Contractor as soon as practicable.

#### 706.24 MEASURE

Structural Steel will be measured by one of the methods as specified herein. The Pay Item Schedule will indicate which method is applicable.

- (A) **LUMP SUM.** The unit of measure for Structural Steel will be the job. No actual measurement will be made.
- (B) **PER POUND.** The unit of measure for the various items of Structural Steel as listed in the Schedule of Prices will be the pound. The number of pounds will be the actual number of pounds of Structural Steel complete in place as computed from approved shop drawings.

The weights of plates shall be computed on the basis of 0.2833 pounds per cubic inch of steel. No allowance will be made for overrun.

Weights shall be computed on the basis of the net finished dimensions of parts as shown on approved shop drawings, deducting for copes, cuts, clips, and all open holes, except bolt holes.

The weight of castings will be computed from the dimensions shown on approved shop drawings, deducting for holes. To this weight will be added 5 percent allowance for fillets and overrun.

The following unit weights in pounds per cubic foot shall apply:

Aluminum, cast or wrought	173.0
Bronze, cast	536.0
Copper-alloy	536.0
Copper sheet	558.0
Iron, cast	445.0
Iron, malleable	470.0
Lead, sheet	707.0
Steel, cast, copper bearing, silicon, nickel and stainless	490.0
Zinc	450.0

Certified scale weights may be substituted for computed weights if approved by the Chief Engineer. In computing on the basis of certified scale weights, fabricated members shall be weighed on approved scales in the presence of the Inspector. If shop paint has been applied to the completed member when weighed, 0.004 of the member's weight shall be deducted from the scale weights to compensate for weight of shop paint.

The weight of field and shop bolts heads, nuts, washers and shank length in excess of grip will be included as follows:

Diameter of Bolt (inches)	Bolts-weight per hundred (pounds)
1/2	19.7
5/8	31.7
3/4	52.4
7/8	80.4
1	116.7
1-1/8	165.1
1-1/4	212.0

The weight of temporary erection bolts, shop and field paint, boxes, crates, and other containers used for shipping, and materials used for supporting members during transportation and erection, shall not be included. No measurement will be made for the weight of weld metal.

The Contractor shall compute the weights of all structural steel from his approved shop drawings and shall submit this information to the Chief Engineer in suitable form for verification. Weights shall be suitably classified, conforming to various items of structural steel listed in the Schedule of Prices.

For each member, there shall be given a complete shop bill, listing all plates, shapes, and other parts, with the weights thereof, a notation of the amount deducted for clips and other cutoff parts, and the net remaining weight. The tabulations shall include summaries identifying and combining the weights of all individual members, and a general recapitulation giving the total weight under each division and the total pay quantity. Three copies of these data shall be supplied to the Chief Engineer.

#### **706.25 PAYMENT**

This work will be paid for as Structural Steel as measured in 706.24(A) and 706.24(B), and the Pay Item Schedule will indicate which method is applicable.

- (A) Payment for Structure Steel will be at the contract lump sum price, which payment will include all materials, labor, equipment, tools, and incidentals necessary to complete the specified work.
- (B) Payment for Structural Steel will be at the contract unit price per pound, which payment will include all materials, labor, equipment, tools, and incidentals necessary to complete the specified work.

## 707 PAINTING

### 707.01 DESCRIPTION

Work consists of the surface preparation and shop and field painting of new and existing steel structures. Reference will be made to Steel Structures Painting Council (SSPC) Steel Structures Painting Manual, Volume II, Systems and Specifications and other relevant SSPC publications. Painting of materials other than steel will be addressed specifically either in 707 or in the contract documents.

### 707.02 MATERIALS

- (A) **GENERAL.** All paints, coatings, component materials, submittal of material samples, laboratory and field tests, and the labeling and shipping of paint containers shall conform to the requirements of 811 unless otherwise specified below.

Solvent used for solvent cleaning shall be in accordance with 811.06.

### (B) PERFORMANCE TESTS AND PRODUCT CERTIFICATION

- (1) The Contractor shall submit manufacturer certifications that the appropriate ASTM tests have been successfully performed on the coating system by an independent testing laboratory. The certification shall show specific test results. In addition, the certified test report shall contain the manufacturer's name and brand name of paint, and the lot numbers of sample from which data is compiled.
- (2) The following information shall be submitted as a complete package for approval for each coat in the system selected at least 2 months prior to the anticipated beginning of painting operations, as applicable to the paints specified for the project:

A one (1) quart sample of each coat (or component, if multiple component paint) in the system.

Infrared curves (2.5 to 15.0 microns) to include curves for the dry film of the vehicle (binder) of each component and for the mixed paint.

Weight per gallon at 77 degrees F.

Percent solids by weight and volume.

Percent of metallic zinc by weight in the cured IOZR primer.

Percent of metallic zinc by weight in the zinc pigment component of the IOZR primer.

Certification from the manufacturer that the zinc dust pigment component of the IOZR primer conforms to ASTM D 520, Type II and that the IOZR primer contains no more than 0.02% lead by weight in the dried film.

Certification from the manufacturer that the material supplied for use as field and repair primer and intermediate and finish coats contain no more than 0.005% lead.

Certification, including a copy of the test report, to the effect that the IOZR primer has been tested and is qualified as Class B (Slip Coefficient 0.50) in accordance with the requirements of Article 10.32.3.2.3, Division I, AASHTO Standard Specifications for Highway Bridges, Sixteenth Edition, 1996.

The manufacturer's recommended method for determining that the IOZR primer has cured sufficiently for bolting of shop connections and application of the intermediate coat.

Technical data sheets, application instructions and material safety data sheets for each coat.

A color chip of the finish coat, of minimum size 8-1/2 inches by 11 inches

Viscosity in Krebs units at 77 degrees F for each coat.

Volatile organic compounds, measured in in pounds per gallon.

- (3) All quantitative parameters shall be expressed either as +/-'s or as maximums and minimums. Test methods used for all parameters shall be quoted.
- (4) All products, including thinners, for the complete system shall be supplied by the same manufacturer and shall be certified as compatible.
- (5) All paints shall be packaged in substantial containers with each bearing a label on which shall be written instructions and precautions for use. Each container shall contain the date of manufacture, the batch number and the product designation.
- (6) The Contractor shall submit product and material safety data sheets and application guides for his proposed system to the Chief Engineer for material approval.
- (7) The Contractor shall supply detailed written instructions from the coating manufacturer on repair procedures, including surface preparation, repair primer, repair intermediate coat, application methods, and any time restrictions. No work will be allowed until these written procedures are submitted to the Chief Engineer. The written procedures shall be followed.
- (8) The manufacturer shall also certify that the coating system has been used successfully for a period of three (3) years in similar service and environment and that the material was applied in coats within manufacturer's recommended dry film thickness. Successful performance shall include sustained adhesion to structural steel. Specific locations, preferably in the mid-Atlantic region or areas of similar climates, shall be given.
- (9) The manufacturer shall have a technical service representative on hand to assist the Contractor the first time that these products are used by the Contractor and shall be available for consultation should any difficulties arise in the use of the products.

### **(C) LABELING AND PACKAGING**

- (1) All containers shall be listed in accordance with ANSI Standard Z129.1.
- (2) Label Requirements – The following information shall be listed in clear, legible type on the label of each container, for each product.

- (a) Product name including component type if applicable.
  - (b) Color name or number of the particular product and component.
  - (c) The lot number or batch number of the product and component.
  - (d) The date of manufacture of the product and component.
  - (e) The manufacturer's name and complete address.
  - (f) Shelf life expiration date.
- (3) Summary mixing instructions shall be listed on the label of each component or reference the appropriate component which lists the mixing ratio.
- (4) Any materials hazardous according to OSHA/EPA regulations shall be listed on the label if they exist in the product in amounts greater than one-tenth of a percent (0.1%) if carcinogenic.

### 707.03 JOB PERFORMANCE

- (A) **GENERAL.** The painting of new or existing structural steel and other metalwork shall include complete preparation of the metal surfaces, application and protection of the drying paint coatings, removal and proper disposal of existing paint, rust, mill scale and hazardous waste, protection of workers and the environment and furnishing all labor, materials, tools, scaffolding and other equipment, and incidentals necessary for proper execution of the work.

Elements to be coated include the new and existing structural steel members, cross frames, diaphragms, shapes, plates, their connection components and steel bearings. Also included shall be all steel components of the bridge deck drainage system and their supports. Excluded from painting shall be light standards, sign structures, electrical equipment and galvanized steel.

For new steel, the Contractor shall apply a three-coat paint system as specified herein or in the contract documents. All coatings shall be in accordance with Section 811.

For maintenance recoating of existing painted metal surfaces in the field, the Contractor shall apply the type and number of paint coatings as specified in the contract documents. All coatings shall be in accordance with Section 811.

- (B) **CAPABILITY OF WORKERS** – All shop and field painting shall be performed by a Contractor/ Subcontractor qualified for certification by the Steel Structures Painting Council (SSPC) Painting Contractors Certification Program (PCCP) for Class 2 work and meeting the requirements of:
- (1) SSPC-QP 1 Contractor qualification for surface preparation and coatings application in the field and,
  - (2) SSPC-QP 2 for hazardous paint (lead or other) removal and,
  - (3) SSPC-QP fabrication shop qualification for surface preparation and protective coating application in a fixed shop facility

- (4) The SSPC certification shall be obtained and evidence submitted to the District as part of the required submittals for this work. Failure to provide the required SSPC certification(s) shall be grounds for disqualification of the painting Contractor or fabrication shop.

**(C) WEATHER CONDITIONS FOR SURFACE PREPARATION AND PAINT APPLICATION**

- (1) With the exception of the inorganic zinc-rich primer (IOZR), no outdoor or field painting shall be performed between December 1 and March 15 without prior approval of the Chief Engineer.
- (2) Surface preparation shall not be performed when the steel surface is below 32°F, within 5°F of the dew point or when anticipated weather conditions would preclude application of the primer on the same day.
- (3) Inorganic zinc-rich (IOZR) primer shall not be applied when the ambient, surface and material temperatures are below 40°F, nor when the Chief Engineer anticipates temperature will drop below 40°F within 24 hours. All other coatings shall not be applied at temperatures below 50°F. No painting shall be done when the steel surfaces are above 110°F, when the air is misty or foggy or within 5°F of the dew point, nor when rain is anticipated, nor when relative humidity exceeds, or is expected to exceed, 85 percent within 18 hours, nor when frost or ice exists on the surfaces to be painted, nor when any other conditions are unsatisfactory for painting as determined by the Chief Engineer.
- (4) Should the manufacturer's requirements for a particular material be more stringent than this specification, the manufacturer's requirements shall prevail. Application of coatings outside of normal temperature/humidity recommended ranges as established by the manufacturer shall be subject to the Chief Engineer's approval on a daily basis.
- (5) If, in the opinion of the Chief Engineer, traffic or construction equipment produces an objectionable amount of dust, the Contractor, at his expense, shall allay the dust for the necessary distance and take any other precautions necessary to prevent dust and dirt from coming in contact with freshly painted surfaces or other surfaces to be painted.

**(D) PAINTING SCHEDULE AND CONTRACTOR'S SUBMITTALS.** Before any painting operations begin the Contractor shall submit in writing to the Chief Engineer his proposed work schedule which shall include:

- (1) A systematic procedure or plan for all cleaning and painting operations.
- (2) A plan for the capture, containment, collection and storage of the waste generated by the work, which includes blasting residue, spent blasting medium, rust, mill scale, paint particles, dust, etc. Included shall be the recovery system for recycling the blasting media. The system shall be capable of adequate removal of dust particles and continuously keeping the grit dry and free of oils, grease and other harmful materials.
- (3) A plan of action, submitted by the Industrial Hygienist, indicating the procedures for monitoring air, soil and water. The plan shall include the type of equipment to be

used and the approximate locations of monitors and test samples for the project area. The Contractor shall also submit a written program for worker protection.

- (4) The type and method of protection against paint spatters drippings, and other disfiguring elements while cleaning and painting over roadways, waterways and areas in vicinity of abutments and piers. Methods of meeting requirements of 707.06 shall also be submitted.
- (5) Drawings and computations showing the type and size of scaffolding, rigging and negative pressure containment systems to be used showing all dimensions, sizes of members, types of materials, required negative pressure and capacity of the specified blasting system with a procedure clearly stating how it will be erected.

The drawings and computations shall be certified in writing by a Professional Engineer registered in the District. All portions of the outline and drawing are subject to the Chief Engineer's approval. Any deviation from approved procedures will be allowed only with the Chief Engineer's approval. Approval does not relieve the Contractor of the responsibility for the safety of his methods and equipment, or from carrying out the work in full accordance with specification requirements. Work shall not commence until approval of the Chief Engineer has been obtained.

- (6) The Contractor shall provide adequate, portable lighting equipment in good working order, of a design approved by the Chief Engineer, and at no cost to the District, to supply adequate illumination to the underside of structures while cleaning and painting and for any inspection.

#### **(E) INSPECTION**

- (1) All work shall be inspected by authorized personnel representing the District. As each operation (cleaning, blasting, spot painting and each coat of painting) is completed and prior to any succeeding operation on a section, the Contractor shall notify the Chief Engineer for approval before the next operation may begin.
- (2) Any work not meeting approval of District inspectors shall be rejected and redone until it meets their approval. The method of correction shall be approved by the Chief Engineer prior to proceeding. Should any work be done which proceeds past the point where inspector approval is required, the Contractor shall, at the option of the Chief Engineer, remove said work back to that point at no additional cost to the District. The Contractor shall correct work or replace material which is found defective. The method of correction shall be approved by the Chief Engineer.
- (3) Cleaning and surface preparation of each section shall be entirely completed and accepted before painting commences in that section. All paint shall be suitably dry throughout a full section and accepted before any succeeding coat of paint is applied in that section. Any paint applied without the prior approval of the Chief Engineer to begin painting shall be removed by sandblasting to bare metal. This corrective work shall be at the sole expense of the Contractor.
- (4) When surface preparations are complete, surfaces shall be checked for cleanliness, smoothness, anchor profile height and dryness. Cleanliness shall meet the job sample previously established. Anchor profile height shall be measured using replicate tape in accordance with ASTM D4417, "Field Measurement of Surface Profile of Blast Cleaned Steel," Method C – Composite Plastic Tape. Dryness shall

be determined by dew point measurement. The Contractor shall perform these determinations, using his own approved test equipment, in the presence of the Chief Engineer. Prepared areas shall be painted as soon they are accepted by the Chief Engineer.

- (5) Dry paint film shall be randomly measured for thickness, and shall be inspected for non-uniform areas, holidays, runs or sags. Areas not meeting specification requirements shall be corrected to the satisfaction of the Chief Engineer.
- (6) Film thickness on edges, welds, rivets, etc. shall be checked by cutting off a paint chip at representative points with a knife and visually comparing with chip taken from an area of known thickness.
- (7) Adhesion and flexibility of the paint film on the metal shall be checked by cutting loose a narrow strip of the thoroughly dried film from the surface with a knife. Flat side of the blade should make an angle of about 30 degrees with the coated surface. Films of good flexibility and adhesion should come off under the knife in a ribbon and edges of the cut should show a beveled appearance without evidence of flaking.
- (8) To facilitate the inspection, the Contractor shall perform the following:
  - (a) The Contractor shall provide the Chief Engineer with one copy each of the following documents, which will become the property of the District upon completion of the work:
    - SSPC Volume 2 of Steel Structures Painting Manual, Systems and Specifications.
    - SSPC-Vis 1-89 Visual Standard for Abrasive Blast Cleaned Steel Surfaces.
    - SSPC-Vis 2, Color Photographic Standards for Evaluating Degree of Rusting on Painted Steel Surfaces.
  - (b) The Contractor shall supply, maintain and replace as necessary, for the use of the Chief Engineer, the following:
    - Two (2) electronic noise level measuring devices that meet EPA Standards.
    - Two (2) Positector 2000(in) Dry Film Coating Thickness Gauges or approved equal.
    - Two (2) Psychro-Dyne Humidity indicators providing wet and dry bulb temperatures for establishing relative humidity and dew point.
    - Two (2) National Weather Service Psychrometric Tables.
    - Two (2) Magnetic thermometers for measuring the surface temperature of metalwork.
    - A sufficient supply of Keane-Tater Surface Profile Compator or Testex Replica Tape for measuring the anchor profile height of the cleaned steel surface.

Upon completion of the contract, the equipment shall remain the property of the Contractor. Additional methods and equipment may be used for inspection procedures by and at the discretion of the Chief Engineer.

- (7) The Contractor shall furnish all necessary apparatus such as ladders, scaffolds, platforms and lighting as required for the inspector to have reasonable and safe access to all work at times deemed necessary by the Chief Engineer for inspection. Rigging shall meet OSHA requirements.

When blast cleaning is performed, the Contractor shall also supply one set of disposable, protective coveralls, daily, for use by the inspector and shall be responsible for proper disposal after they are used. The Contractor shall also supply half face respirators and a sufficient number of cartridges for District inspection purposes as needed by the Chief Engineer. Appropriate cartridges for particulates and organic vapors shall be supplied. The Contractor shall be responsible for disposal of the cartridges after they are used.

#### **(F) REPAIRS**

- (1) All defective or damaged areas shall be repaired, at the Contractor's expense. Said areas shall be coated with the full system as required in these specifications. Repair may be limited to touch up of damaged areas but in no way shall the number of coats, the required coating system, or the dry film thickness of each coat be modified because of the repair procedure. Should an area be damaged through to the steel substrate, said area shall receive the specified degree of surface preparation as well as the full coating system as a repair remedy.
- (2) Defects in the paint film, including damage such as scratches and areas of non-adherent paint, and rusting in excess of Rust Grade 8, as determined using SSPC-Vis 2, shall be repaired.
- (3) Prior to shipment of steel to the project site, all areas of non-adherent paint and damaged areas which exhibit rusting shall be re-blasted to the SSPC-SP10 standard and reprimed with the IOZR primer on the same day.
- (4) Subsequent to shipment of steel to the project site:

All damage to the paint film, including rusting, which occurs prior to erection of the steel, shall be repaired before steel is erected.

Minor damaged areas such as scratches, not exceeding one square foot in area, shall be reblasted to the SSPC-SP 6 standard, or may, at the Contractor's option, be prepared in accordance with SSPC-SP 11, Power Tool Cleaning to Bare Metal, after which they shall be reprimed on the same day using the field primer. Larger areas of defects, if directed by the Chief Engineer, shall be re-blasted to the SSPC-SP 6 standard and re-primed the same day using the field primer.

In no case shall the field primer be applied to any faying surfaces prior to field erection and installation of the fasteners. Necessary repairs to the faying surfaces shall be made as directed by the Chief Engineer.

(5) All damaged areas shall receive the full system of either the IOZR or field primer and intermediate and finish coats as specified elsewhere in this Specification.

- (G) **MAINTENANCE AND PROTECTION OF HIGHWAY AND PEDESTRIAN TRAFFIC AND ADJACENT PROPERTY.** The Contractor shall be responsible for any disfigurement by splatters, smirches and splashes of paint on vehicular traffic and pedestrians, adjacent property and on any portion of the structure or area under the structure. The Contractor shall also be responsible for damage to the structure and adjacent property through the use of scaffolding and other equipment.

Proper drop cloths shall be required to minimize splatters of paint on concrete surfaces. Any damage or disfigurement shall be replaced or cleaned at the sole expense of the Contractor.

#### 707.04 ENVIRONMENTAL PROTECTION

##### (A) PROTECTION OF WORKERS AND THE ENVIRONMENT.

- (1) Protection of workers and of the environment shall be provided by the Contractor as an integral requirement of the performance of the work. The Contractor shall employ the best current methodology for protection of the worker/employee and the environment by containment of all hazardous material in consideration of the following:

The release of volatile organic compounds (VOC's) and isocyanates during painting.

Protection of workers to prevent exposure to hazardous waste, VOC's, isocyanates, and any other compound deemed hazardous by the jurisdictional agencies.

U.S. Environmental Protection Agency (EPA), U.S. Occupational and Health Administration (OSHA), and District of Columbia Department of Health (DOH) requirements and guidelines pertaining to all of the above.

- (2) The VOC regulations on bridge projects in the District of Columbia are subject to the Federal Rules for National Volatile Organic Compound Emissions Standards for Architectural Coating, published September 11, 1998 by the Environmental Protection Agency, and its subsequent amendments. The D.C. Department of Transportation will not restrict the application of coatings for architectural, industrial and maintenance purposes on bridge structures to the limits of Section 700 of 20 DCMR. Coatings and paints with VOC contents that comply with the Federal Standards would not be subject to the limits of Section 700, 20DCMR.

The Contractor shall obtain all recent Federal Regulations and shall follow the restrictions therein for painting operations.

The Contractor, with the assistance of the D.C. Department of Transportation, shall obtain a permit from DOH to engage in blast cleaning and painting operations. Applicable portions of DCMR Title 20 Section 605 are as follows:

### 605 CONTROL OF FUGITIVE DUST

605.1 Reasonable precautions shall be taken to minimize the emission of any fugitive dust into the outdoor atmosphere. The reasonable precautions shall include, but not be limited to, the following:

- (g) ...and in the case where dry sandblasting or dry abrasive cleaning is necessary: Use of enclosed areas or hoods, vents, and fabric filters.

### 700 ORGANIC SOLVENTS

. The Contractor is encouraged to minimize organic solvents discharged by using low VOC rated coatings for the specified paint system.

It is recommended that the Contractor obtain a complete copy of DCMR 20 prior to preparation of bids. Publications may be purchased by mail or in person from:

D.C. Office of Documents and Administrative Issuances  
 One Judiciary Square, Room 520  
 441 4th Street, N.W.  
 Washington, D.C. 20001

### (C) MONITORING.

- (1) **Industrial Hygienist** – When existing structural steel is blast cleaned, the Contractor shall employ the services of an Industrial Hygienist certified by the American Board of Industrial Hygiene. The hygienist shall have errors and omissions insurance coverage and shall be experienced in this type of work.

The hygienist shall monitor worker exposure and ambient air and analyze the soil before, during and after cleaning operations at locations selected by the hygienist and approved by the Chief Engineer. All sampling and testing shall be performed by the industrial hygienist or an employee of that firm under the direct supervision of the hygienist.

Due to the results of these analyses, adjustments to the containment system may be required by the Chief Engineer. The Contractor shall provide a copy of all reports and analyses, including calibrations of all instruments, to the Chief Engineer in a timely manner.

- (2) **Lead/Chromium Exposure Monitoring** – The Contractor shall institute a monitoring program for all employees who occupy a position where they may be exposed to lead and/or chromium. Blood lead/chromium levels shall be taken prior to beginning work and at least every month for the first six months and every two months, thereafter. Blood lead/chromium tests shall be performed by a clinical laboratory certified by OSHA.

If blood analysis shows a blood lead level of 40mg/dl, blood samples shall be collected every month until two consecutive tests indicate a blood level of less than 40 mg/dl. An employee shall be removed from exposure to lead if his/her blood lead level is at or above 60 mg/dl and/or if the average of the last three blood tests or the average of all blood tests in the previous six (6) months is at or above 50 mg/dl. A follow-up blood test shall be taken within two weeks after any test which exceeds the numerical criteria for medical removal.

The medical removal of workers is intended to protect the employees' health and shall not penalize the worker by loss of earnings, seniority or other employment rights and benefits. An employee can be returned to his/her former position when two consecutive blood lead levels are at or below 40 mg/dl.

The Contractor shall provide the employee with a copy of all blood lead/chromium results. Each employee shall receive a written notice of his/her blood lead level within five days after receipt of the results. It is recommended that a permanent record be kept by the Contractor of employee's blood lead/chromium results.

- (3) **Soil Sampling and Testing** – The industrial hygienist shall test for lead contamination in the vicinity of the project by conducting periodic soil sampling and testing. Soil samples shall be taken at a minimum of six (6) locations at locations determined by the hygienist as approved by the Chief Engineer. At least three (3) sets of soil samples shall be taken; one prior to the start of work, one at the midpoint of construction and one at the completion of all cleaning operations. Soil analyses shall be performed in accordance with SSPC-Guide 6(CON), paragraph 5.5.5, "Method E" as directed by the hygienist.
- (4) **Air Monitoring** – The industrial hygienist shall monitor the quality of air within the vicinity of the project. Work exposure monitoring tests shall be performed outside the face mask and inside the hood of workers and outside and downwind of the containment system. Air monitoring shall begin one week prior to beginning work, during the first two weeks of blast cleaning operations and one month later unless otherwise directed by the Chief Engineer. The number of tests required shall be determined by the Contractor's industrial hygienist and approved by the Chief Engineer. If the data measured is acceptable as determined by an industrial hygienist, additional monitoring will only be required when problems arise as determined by visual assessments of the Contractor's operations. Visible residue on the ground or visible dust shall not be acceptable.

The method for assessing the quantity of emissions shall be in accordance with SSPC-Guide 6(CON), paragraph 5.5.1(a)(2), "Level 1 Emissions". Air monitoring in accordance with paragraph 5.5.3 "Method C" shall be performed to insure compliance with National Ambient Air Quality Standards according to 40 CFR, Part 50, which is 150 mg/m<sup>3</sup> over a 24 hour time period.

The Contractor shall provide dust collectors and air flow systems capable of satisfying ambient air and worker exposure requirements. The containment structure shall be checked constantly for holes, rips or tears during cleaning and painting operations. Should any leaks be found, the Contractor shall immediately cease all cleaning or painting operations until such defects are repaired.

#### **(D) BLAST CLEANING OF EXISTING STEEL.**

- (1) **Hazardous Waste** – The Contractor is cautioned that the existing paint coatings may contain lead and/or other hazardous elements and compounds and that all residues resulting from blast cleaning, including paint, rust, mill scale and blasting media may be classified as hazardous waste as defined by SSPC-Guide 7(DIS) and all applicable Federal or District regulations. The Contractor is required under this contract to dispose of these materials as hazardous waste as required by the

applicable regulations. The Contractor shall obtain an EPA hazardous waste generator identification number from the District.

- (2) **Containment Systems** – Materials resulting from blast cleaning in the field shall not be allowed to fall on the ground or become airborne outside the immediate work area. A negative air pressure containment system meeting the requirements of SSPC-Guide 6(CON), Class 3, shall be required to prevent the escape of fugitive dust into the environment. All rust, scale, loose paint, grease, oil and materials used in blast cleaning shall be stored and disposed of as hazardous waste in conformance with District, EPA and OSHA requirements, as applicable.

The containment system shall be capable of maintaining no visible discharge when blast cleaning is performed in the center of the containment. Only slight or minor airborne discharge will be permitted when work is being performed near the end or sides of the containment. Air flow shall be established in the containment such that fugitive dust is directed away from the work area. The abrasive recovery/recycling system shall have adequate filters and controls so no visible discharge occurs during recovery, recycling or handling of the abrasive.

- (3) **Worker Protection** – Workers performing abrasive blast cleaning shall wear full body protective clothing with a continuous flow, airline, abrasive blasting respirator for protection from lead and/or silica dust or fumes. The garment material shall permit the passage of air and shall be impermeable to lead fumes, mist or dust. All respirators must be an approved type, certified by the National Institute for Occupational Safety and Health (NIOSH).

The Contractor shall ensure that all protective clothing is removed at the completion of a work shift only in designated change areas which are sufficiently separated from other facilities. All contaminated protective clothing which is to be cleaned, laundered or disposed of shall be placed in a closed container, located in the designated change area, which prevents dispersion of lead. The container shall be labeled as containing clothing contaminated with lead. Provisions shall be made for the cleaning, laundering or disposal of protective equipment and repair or replacement of equipment as needed to maintain their effectiveness. Adequate washroom and shower facilities shall be located adjacent to the designated change area.

- (4) **Temporary Storage of Hazardous Waste** – The Contractor shall obtain a temporary storage site for hazardous wastes meeting the requirements of SSPC-Guide 7(DIS). This site shall be a fenced and locked area where the public does not have access, and is not in a flood plain. The area shall be marked as containing hazardous waste. The material shall be kept in closed containers while in temporary storage. No hazardous waste shall be kept longer than 90 days in the temporary storage site before shipment. The Contractor shall prepare all manifests for transportation and disposal of the waste. The completed manifest containing all required signatures shall be submitted to the Chief Engineer. The hazardous waste shall then be transported to an approved hazardous waste disposal site.
- (5) **Field Repairs** – If blast cleaning is required during field repair of damaged paint surfaces, the Contractor shall also be subject to Section 605, for control of fugitive dust. The Contractor is liable for all expenses and time delays in performing this

repair work. Included in this work is prior approval of detailed procedures with types of equipment to be used.

- (E) **PAINTING OPERATIONS.** For painting operations, full ventilated enclosures are required to prevent overspray into the atmosphere and onto private property. Workers engaged in spray painting operations shall be provided with full body protection with either a powered air purifying respirator or an air supplied respirator. Drop cloths shall be intended to be used only as a secondary (backup) system to prevent paint from falling on the ground.
- (F) **CONTRACTOR'S METHODS.** The methods proposed by the Contractor shall be approved by the Chief Engineer before work may proceed. Approval by the Chief Engineer does not relieve the Contractor of any responsibility for meeting all Federal, State and local regulations on air quality, water quality, hazardous materials, hazardous waste, public health or the laws of any regulatory agency.
- (G) **MEETINGS.** The Contractor, with the Chief Engineer in attendance, shall hold meetings to inform all workers of the potential safety and health hazards of this work and what steps are being taken to reduce the risk of contamination, and to give instructions in the use of protective equipment. The protection of the workers and the environment and the recovery, transportation and disposal of hazardous waste shall be of the utmost importance.

#### 707.05 COATING SYSTEMS

- (A) **NEW STRUCTURAL STEEL.** New structural steel shall receive the following coatings selected from the list of paint systems found in the contract documents:

**Stripe Coat** – All edges, including flanges, shop-installed nuts and bolts, and welds, shall receive a stripe coat of primer just prior to application of the primer coat. The stripe coat shall be brush applied. The paint shall either be constantly agitated, or stirred just prior to application.

**Primer** – One shop coat of inorganic zinc-rich (IOZR) primer conforming to the requirements as specified herein to a dry film thickness (DFT) in accordance with the manufacturer's recommendations. This coat shall be applied the same day of blast cleaning.

**Intermediate** – One coat of epoxy paint conforming to the requirements specified herein, with a minimum DFT in accordance with the manufacturer's recommendations.

**Finish** – One (or more) coat(s) of urethane topcoat, tinted as specified in the contract documents, conforming to the requirements specified herein with a minimum DFT in accordance with the manufacturer's recommendations to the total DFT specified for the project .

Following installation in the field, new steel shall receive touch-up coats on damaged areas as specified in 707.03(F), REPAIRS.

- (B) **EXISTING STRUCTURAL STEEL.** All existing metal surfaces, except those specifically excluded, shall receive the following coatings selected from the list of paint systems found in the contract documents.

**Primer** – One coat of organic-zinc field primer conforming to the requirements specified herein with a minimum dry film thickness (DFT) in accordance with the manufacturer’s recommendations.

**Intermediate** – One coat of epoxy paint conforming to the requirements specified herein with a minimum DFT in accordance with the manufacturer’s recommendations.

**Finish** – One or more coats of urethane paint, tinted as specified in the contract documents, conforming to the requirements specified herein with a minimum DFT in accordance with the manufacturer’s recommendations to a total DFT specified for the project.

- (C) **APPROVED PAINT SYSTEMS.** The listing of all paint coating systems found in section 811 of these specifications have been given conditional approval, subject to meeting composition, physical properties, performance criteria and environmental criteria.

Alternate systems, selected from the current approved lists of the Maryland State Highway Administration and the Virginia Department of Transportation, may be submitted for approval. Said systems shall be accompanied by full documentation, including the state’s list of approved systems. All products, including thinners, for the complete system shall be from the same manufacturer.

- (D) **PREPARATION OF PAINT.** All paint shall be used directly from original shipping containers without any additions or thinning except lampblack. Lampblack shall be added only as directed by the Chief Engineer.

All ingredients in any container of paint shall be thoroughly field mixed before use and agitated often enough during application to keep the pigment in suspension. In cool weather paint may be warmed by slowly heating the paint containers in warm water. When warming paints their temperature shall not be permitted to exceed 100°F.

Paint first shall be mixed in the original container and not transferred until all settled pigment is incorporated into the vehicle. However, a portion of the vehicle may be poured off temporarily to simplify mixing.

Mixing shall be done by mechanical methods except that hand mixing will be permitted for original containers up to 5 gallons in size. Mixing in open containers shall be done in a well ventilated area away from sparks or flames. Paint shall not be mixed or kept in suspension by means of an air stream bubbling under the paint surface.

Where a skin has formed in the container, the skin shall be cut loose from the sides of the container, removed and discarded. If such skins are thick enough to have a detrimental effect on the composition and quality of the paint, the paint shall not be used.

The paint shall be mixed in a manner which will insure breakup of all lumps, complete dispersion of settled pigment and a uniform composition. When mixing is done by hand, most of the vehicle first shall be poured off into a clean container. The pigment shall be lifted from the bottom of the container with a broad, flat, clean paddle, lumps shall be broken up and the pigment thoroughly mixed with the vehicle. The poured off vehicle then shall be returned to the paint with simultaneous stirring, or pouring repeatedly from

one container to another until composition is uniform. The bottom of the container shall be inspected for unmixed pigment.

All pigmented paint shall be strained after mixing; strainers shall consist of cheesecloth or a medium mesh screen (No. 6 mesh) and shall show only a trace of skins and undispersed lumps.

Lampblack pastes shall be wetted with a small amount of paint and thoroughly mixed. The thinned mixture shall then be added to the large container of paint and mixed until color is uniform.

Paint which does not have limited pot life or does not deteriorate on standing may be mixed at any time before using. If settling has occurred the paint must be remixed immediately before using. Paint shall not remain in spray pots, painter's buckets, etc., overnight, but shall be gathered into the original container or a central container and remixed before use.

Paint not meeting the strainer test, or with thick skins detrimental to composition, or not meeting the test requirements in accordance with 811.01, shall be rejected on this basis alone and removed from the work area to the satisfaction of the Chief Engineer.

All varsol, turpentine and any other solvents shall be stored at least 300 feet away from any paint being stored in previously opened containers, paint being mixed, and paint operations. Any paint which becomes mixed or contaminated with any such varsol, turpentine, solvents, or any other foreign substance shall be rejected on this basis alone and immediately removed from the work area to the satisfaction of the Chief Engineer.

## **707.06 SURFACE PREPARATION**

### **(A) STANDARDS FOR SURFACE PREPARATION**

- (1) The degree of preparation attained will be determined by the use of SSPC-Vis 1-89, Visual Standard for Abrasive Blast Cleaned Steel. Abrasive blasting of structural steel shall be performed using recyclable abrasives in the form of steel shot, steel grit, or a combination of the two, in a size or combination of sizes sufficient to impart the specified surface profile. Abrasives that contain greater than 110 ppm chloride, sulfate or other similar corrosives shall not be used. Dehumidification equipment shall be used to protect the abrasive from atmospheric corrosion.
- (2) After blast cleaning, the surface of existing steel shall have an anchor profile height of a minimum of one (1) mil, and the surface of new steel shall have an anchor profile height of one (1) to three (3) mils in a dense uniform pattern of depressions and ridges as determined by the Keane-Tator Surface Profile Comparator or Testex Replica Tape. If necessary, the area shall be re-blasted to give the specified anchor profile height.

### **(B) INITIAL SURFACE PREPARATION.** Prior to blast cleaning, the following operations shall be performed:

- (1) All weld spatter and slag shall be removed and all sharp corners on the bottom flanges and cross frame members shall be rounded to a 1/8+ inch radius or equivalent flat surface.

- (2) All fins, tears, slivers and burred edges that are present on any steel member, or that appear during the blasting operation, shall be removed by grinding and the area re-blasted to provide the specified surface profile.
- (3) All drilling and reaming of holes in the steel shall be completed and free of burrs or other imperfections, such as torn or ragged edges prior to blast cleaning.
- (C) **BLAST CLEANING OF NEW STEEL.** Surfaces of new steel shall be prepared for shop painting in accordance with SSPC Steel Structures Painting Manual, Volume 2, Surface Preparation No, 10, Near-White Metal Blast Cleaning.
- (D) **BLAST CLEANING OF EXISTING STEEL.** Surfaces of existing steel shall be prepared for repainting by blast cleaning, except those which are considered inaccessible for this procedure, in accordance with SSPC Steel Structures Painting Manual, Volume 2, Surface Preparation Specification No. 6, Commercial Blast Cleaning. As an alternative, inaccessible areas shall be prepared in accordance with SSPC-SP11-87T, Power Tool Cleaning to Bare Metal.

Special attention shall be given to the procedures described in Sections 5 and 7 of SSPC-SP 6 which describe required surface preparation before and after blast cleaning. Soil, concrete splatter, oil, grease, salts, dirt film, or other foreign matter shall be removed by brushing with stiff wire brushes, scraping and washing with cleaning solutions before blast cleaning. All fins, tears, slivers, sharp edges, weld spatter and burning slag shall be removed by grinding and the area re-blasted to achieve required surface profile.

If directed by the Chief Engineer, an additional blast cleaning of the surface shall be done in all areas subject to chloride contamination, such as expansion joints. The appearance of the prepared surfaces shall be compared with the appropriate photographs in SSPC-Vis 1-89. The Chief Engineer will be the sole-approving authority of the adequacy of the surface preparation.

The Contractor is cautioned that if the surfaces of existing structural steel are believed to be coated with mill scale, the removal of the mill scale is included in the required work.

Sand-blast and water-blast techniques will not be permitted.

After the prepared surfaces of existing steel have been inspected and accepted, the surfaces, except for faying areas, shall be primed the same day. Should surface rust-back occur before primer application, the affected area shall be blast cleaned at no extra cost to the District.

The Contractor shall take the necessary measures to protect previously painted surfaces adjacent to blast cleaning operations from damage resulting from these activities. These measures shall not relieve the Contractor of the responsibility of repairing all damage to newly painted surfaces as a result of the blast cleaning operations.

- (E) **WOOD SURFACES.** Wood surfaces shall be prepared by scraping with wood scrapers or sanding with coarse and/or fine sandpaper and dusting the surfaces, or a combination of these methods, until surfaces are smooth and un-splintered.

**707.07 GENERAL REQUIREMENTS FOR PAINT APPLICATION**

- (A) **GENERAL.** All paint shall be applied in accordance with SSPC-PA1, Shop, Field and Maintenance Painting and as hereafter specified.
- (B) **PAINT COATINGS.** All new structural steel shall be painted at the fabrication shop with one coat of inorganic zinc rich primer (IZOR) as specified in 707.05(A). All existing structural steel shall be painted with one coat of field primer as specified in 707.05(B). All structural steel, except for dam assemblies, surfaces in contact with concrete and faying surfaces shall then receive intermediate and finish coats of acrylic paint.
- (C) **GALVANIZED STEEL.** Unless otherwise specified, galvanized surfaces shall not be painted. Machine finished surfaces or portions thereof which are to bear and slide on other surfaces shall not be painted, but shall be coated prior to shipping with a corrosion inhibiting multipurpose grease or other specified coating.
- (D) **STORAGE AND MIXING OF PAINT.** All paint shall be stored, mixed, thinned, and applied in accordance with the manufacturers recommendations. In cases when the manufacturer's recommendations differ from the requirements specified herein, those which are more stringent shall govern. In cases where manufacturer's recommendations are more lenient than the requirements in this specification, they shall govern only if specifically authorized by the Chief Engineer.

All paint shall be mixed using power mixers of the type recommended by the manufacturer. Only complete kits of the inorganic zinc-rich (IOZR) primer shall be mixed. IOZR primer which exceeds its pot life shall be discarded. Paints shall be frequently mixed during application. IOZR primer shall be continuously agitated and shall be applied from containers equipped with a mechanical agitator which shall be in constant use during application. Paints shall be frequently remixed during application. Paints shall be thinned only with prior approval of the Chief Engineer.

- (E) **CLEANING OF PREPARED SURFACES.** Prior to application of each coat, the surfaces to be painted shall be cleaned as necessary so as to be dry and free of dirt, grease and oil contamination. All residues of abrasives, paint and dust remaining after blast cleaning or other operations shall be removed using a commercial grade vacuum cleaner equipped with a brush type cleaning tool or by double blowing with clean air. If the double blowing method is used, the top surfaces of all steel shall be vacuumed after the double blowing operation is complete. Compressed air used in this operation shall be clean and free of oil, grit and moisture.
- (F) **COMPRESSED AIR.** Compressed air used for all operations, including abrasive blasting, cleaning and painting shall conform to ASTM D 4285. All compressed air supply lines shall be provided with oil traps and moisture separators, which shall be emptied and/or changed, as appropriate, on a regular basis. Separators and traps shall be located at the abrasive pots and material containers instead of at the compressors.
- (G) **APPLICATION METHODS.** IOZR primer shall be applied by spraying, except that brushes may be used to facilitate coating of and around fasteners. Other paint coatings may be applied by any combination of methods or equipment that are recommended by the manufacturer. If rollers are used, they shall be of a type which does not leave a

stippled texture in the paint film. Rollers shall be used only on flat, even surfaces and shall be followed by a brush to level off any bubbles.

Application of paint shall result in a tight film of specified thickness, well bonded to the metal or underlying coatings, including all crevices and corners and shall be free from laps, streaks, sags, bubbles, runs, overspray, dry spray, shadow-through, skips, excessive film buildup, misses and other defects. If required by the Chief Engineer, edges shall be striped with a longitudinal motion and fastener components with a rotary motion immediately prior to the application of the full coat.

- (H) DRY FILM THICKNESS REQUIREMENTS.** Except as noted in the following paragraph, the IOZR and field primer shall be applied to a dry film thickness (DFT) of 3 to 5 mils above the surface profile, and the intermediate and finish coats shall each be applied to a DFT of 3 to 5 mils. The nominal cumulative DFT after application of the finish coat shall be 9 mils, and shall be defined as a minimum of 8 and a maximum of 15 cumulative mils above the surface profile.

IOZR shall be applied to a minimum DFT of 4 mils above the surface profile on the interior surfaces of box beams not receiving intermediate and finish coats.

DFT's shall be determined in accordance with SSPC-PA 2, Measurement of Dry Paint Thickness with Magnetic Gages, except that the 80% tolerance will not be allowed.

**(I) APPLICATION METHODS.**

- (1) CONVENTIONAL AIR SPRAY APPLICATION.** Spraying shall be done with a suitable spray gun of a type and with a method of operation approved by the paint manufacturer for the paint used, without thinning, and acceptable to the Chief Engineer. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. Air from the spray gun impinging against the surface shall show no condensed water or oil. Proper uniform air pressure shall be maintained so as to secure even operation.

Spraying operations shall be carried out so as to secure an even paint film of uniform thickness over all areas to be painted. Thickness of paint film by spray painting shall be equivalent to that secured by approved brush painting and that specified, as measured by a magnetic film thickness gauge. When necessary to secure uniform coverage and to eliminate wrinkling, blistering and airholes, spray painting shall be followed immediately by brush painting.

- (2) AIRLESS SPRAY APPLICATION.** The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The equipment shall be maintained in proper working condition.

Paint ingredients shall be kept uniformly mixed in the spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

Fluid tips shall be of proper orifice size and fan angle, and the fluid control gun of proper construction, as recommended by the manufacturer of the material being

sprayed and the equipment being used. Fluid tips shall be of the safety type with shields to prevent penetration of the skins by the high pressure stream of paint.

The air pressure to the paint pump shall be adjusted so that the paint pressure to the gun is proper for optimum spraying effectiveness. This pressure shall be sufficiently high to properly atomize the paint. Pressures considerably higher than those necessary to properly atomize the paint should not be used.

Spraying equipment shall be kept clean and shall utilize proper filters in the high pressure line so that dirt, dry paint, and other foreign material are not deposited in the paint film. Any solvents left in the equipment shall be completely removed before applying paint.

The trigger of the gun shall be pulled fully open and held fully open during all spraying to insure proper application of paint.

Paint shall be applied in a uniform layer with overlapping at the edges of the spray pattern. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.

All runs and sags shall be brushed out immediately or the coating shall be removed and the surface repainted.

Cracks, crevices, blind areas of all rivets and bolts, and all other inaccessible areas shall be painted by brush, daubers, or sheepskins.

Paint shall be suitable for the particular spray application method used.

Particular care shall be observed with respect to paint temperature and operating techniques in order to avoid deposition of paint which is too viscous, too dry, or too thin.

Airless paint spray equipment shall always be provided with an electric ground wire in the high pressure line between the gun and the pumping equipment. Further, the pumping equipment shall be suitably grounded to avoid the build-up of any electrostatic charge on the gun. The manufacturer's instructions shall be followed regarding the proper use of the equipment.

- (3) **BRUSH APPLICATION.** Brushes shall be of a style and quality that will enable proper application of paint. Round or oval brushes shall be used for painting rivets, bolts, irregular surfaces, and rough or pitted steel. Wide, flat brushes, not having a width over five (5) inches, shall be used for large flat surfaces.

The brushing shall be done so that a smooth coat as nearly uniform in thickness as possible is obtained. Paint shall be worked into all crevices and corners where possible. All runs or sags shall be brushed out. There shall be a minimum of brush marks left in the applied paint. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskins.

- (4) **ROLLER APPLICATION.** Roller application may be used on flat or slightly curved surfaces and shall be in accordance with the recommendations of the paint manufacturer and roller manufacturer. Paint rollers shall be of a style and quality that will enable proper application of paint having the continuity and thickness required.

Roller application shall not be used on irregular surfaces such as rivets, bolts, crevices, welds, corners, or edges.

### 707.08 SHOP PAINTING

(A) The Contractor has the option to apply the intermediate and finish coats at the fabrication shop. In this case, all requirements that apply to the application of intermediate and finish coats stated elsewhere in this specification shall apply. Choice of this option shall not relieve the Contractor of the obligation to exercise all reasonable care to protect the surface coatings in the storage, shipping and erection of structural steel and during the placement of concrete.

(B) If the Contractor exercises the option to apply the intermediate and/or finish coat at the fabrication shop, the faying surfaces shall be masked off. Intermediate and finish coats shall be applied to the exposed surfaces at bolted connections only after installation of the fasteners has been completed.

(C) The following restrictions apply to application of the IOZR primer:

The primer shall be applied the same day that the surface is blast cleaned. Surfaces that are not primed the same day they are blast cleaned shall be re-blasted to the specified degree of surface preparation prior to application of the primer.

The primer shall be continuously agitated during mixing and application.

After mixing, the primer shall be strained through a 30 to 60 mesh screen.

(D) After application of the IOZR primer:

Zinc salts shall be removed by water blasting.

Dry overspray shall be removed by rubbing with a wire screen. Where such an operation results in deficient DFT, the area affected shall be re-blasted to the specified degree of surface preparation and the primer reapplied.

Primer which exhibits mud cracking shall be re-blasted to the specified degree of surface preparation and the primer reapplied.

The dry film thickness (DFT) of the primer shall be measured. Areas exhibiting deficient or excessive DFT shall be re-blasted and the primer reapplied to the specified DFT.

(E) IOZR primer shall be cured in accordance with the manufacturer's recommendations and as follows prior to application of the intermediate coat and before bolting of connections:

Solvent based IOZR primer shall cure for a minimum of 24 hours at 50° F or above and 50% relative humidity or above.

Water based IOZR primer shall cure for a minimum of 24 hours at 50° F or above and 85% relative humidity or above.

All small cracks, cavities, and open seams around crimped stiffeners, connections, etc., shall be caulked with an approved caulking putty, and allowed to semi-dry before the prime coat is applied.

Surfaces not in contact but inaccessible after shop assembly shall be given an additional coat and shall be applied at a minimum dry film thickness of 1.5 mils.

With the exception of faced abutting joints, machine finished surfaces, including bearing rockers and pins, pin holes, sliding bearing contact areas, rocker-base plate contact areas, etc., shall be coated with Lubriplate 630AA, Drydene Multi-white, Rust Inhibitor, or approved equal as soon as practicable after cleaning.

Areas to be field welded shall be given 1 coat of rust- inhibitive petrolatum primer conforming to requirements of 811.03(I).

Erection marks and weight marks shall be reapplied after shop painting unless marker tags are attached.

Material shall not be loaded for shipment until it is thoroughly dry and in any case not less than 24 hours after shop paint has been applied. No degree of tackiness shall be present at the time of loading.

#### **707.09 FIELD PAINTING**

- (A) In the case where the Contractor does not exercise the option to apply both intermediate and finish coats in the fabrication shop and not more than two weeks prior to application of the first field coat to the new steel, the exposed surfaces to be coated shall be cleaned by a high pressure water wash (800 psi. minimum), and dried, or allowed to dry, prior to application of the next coat of paint. The water shall meet the requirements of 822.01.
- (B) Additionally, in cases where a winter season has elapsed since application of the previous coat of paint to either new or existing steel, said surfaces shall be cleaned, as described in the previous paragraph, not more than two weeks prior to the application of the next coat of paint.
- (C) Any areas exhibiting rusting in excess of Rust Grade 8, as determined using SSPC-Vis 2, or where this required cleaning results in failure of previously applied paint, shall be repaired as specified in 707.03(F).
- (D) Field primer shall be applied the same day the surface is blast cleaned. Surfaces that are not primed the same day they are blast cleaned shall be re-blasted to the specified degree of surface preparation and recoated with field primer.
- (E) Prior to application of the intermediate coat:

Dry overspray shall be removed by rubbing with a wire screen.

Primer which exhibits mud-cracking shall be removed. The area shall be reblasted to the specified degree of surface preparation and the primer reapplied.

Surfaces which exhibit rusting in excess of Rust Grade 8, as determined using SSPC-Vis 2, shall be re-blasted to the specified degree of surface preparation and the primer reapplied.

Zinc salts shall be removed by water blasting.

The dry film thickness (DFT) of the primer shall be measured. Areas exhibiting deficient or excessive DFT shall be re-blasted and the primer reapplied to the specified DFT.

- (F) The intermediate coat, if applied by spraying, shall be mist coated over the IOZR primer prior to application of the full wet film thickness, if necessary, in order to prevent bubbling.
- (G) The field primer and intermediate coat shall cure for the minimum drying period as stated by the manufacturer and shall not be recoated until verified by the Chief Engineer. Additionally, the paint shall have
- (H) Prior to application of the finish coat:

The cumulative DFT of the prime and intermediate coats shall be measured. The measured DFT shall be from 5 to 10 mils above the surface profile, except that the 80% tolerance specified in SSPC-PA 2 will not be allowed. Dry film thickness shall be determined in accordance with SSPC-PA 2, Measurement of Dry Film Thickness with Magnetic Gauges.

Surfaces which exhibit rust in excess of Rust Grade 8, as determined using SSPC-Vis 2, shall be re-blasted to the specified degree of surface preparation and the primer and intermediate coats reapplied.

- (I) After application of the finish coat, the cumulative dry film thickness shall be measured and shall be between 8 and 15 mils, except that the 80% tolerance specified in SSPC-PA 2 will not be allowed.
- (J) Areas exhibiting DFT's outside these limits shall be corrected as directed by the Chief Engineer.

All paint shall be purchased in the tinted condition and under no circumstances shall tinting be accomplished on the project except by adding lampblack. A color sample of the proposed paint shall be submitted to the Chief Engineer for approval prior to use on the job.

- (K) **CONSTRUCTION METHODS.** Cleaning and painting shall proceed by sections usually consisting of a complete span, bay, portal, as approved by the Chief Engineer. Field painting of new metalwork shall not start until the concrete deck slab has been placed and all removable formwork has been removed. If false work is not utilized for a painting scaffolding, suitable measures as approved by the Chief Engineer shall be provided to protect any traffic using roadways under structures from paint splatters, spray and cleaning operations.

All small cracks, cavities, and open seams around field splices and other field connections shall be caulked with an approved caulking putty, and allowed to semi-dry.

New open grid steel decking shall receive two top coats when erected; all bars shall be completely painted and dry before structure is opened to traffic. Maintenance painting of open grid steel decking shall exclude surfaces of the grate bars exposed to vehicular traffic. However, grate bars in sidewalks, safety walks, and medians shall be completely painted.

- (L) **PAINTING GALVANIZED METAL.** New galvanized metal shall not be painted. When painting of existing galvanized metal is specified in the contract documents, surfaces first shall be cleaned in accordance with 707.06(B) and then primed with 1 complete coat of zinc dust-zinc oxide primer conforming to requirements of 811.03(H), and a top coat conforming to 811.05(A) at 1.0 mil each.
- (M) **PAINTING WOOD.** Wood items shall be given 1 coat of wood primer-sealer conforming to requirements of 811.03(J) prior to field painting or maintenance painting. Primer-sealer preferably shall be permitted to dry before paint is applied; otherwise primer-sealer shall dry to touch (heavy thumb pressure).

For new construction or when two coats of white paint are required, the first coat shall conform to requirements of 811.05(E)2, except that lampblack tinting shall be used. Final field coat shall conform to the requirements of 811.05(E)2.

For maintenance painting, the number of coats shall conform to requirements of the contract documents.

#### **707.10 MEASURE AND PAYMENT**

The unit of measure for painting will be the lump sum. No actual measurement will be made.

Painting will be paid for at the contract lump sum price for the accepted items in the Schedule of Prices, which payment will include all cleaning and preparation of the surfaces, application and protection of drying paint coats, repair of damaged or unsatisfactory paint coats, application of paint to bridge deck drainage, protection of all portions of structure or structures against any disfigurement and against any physical damage, maintenance and protection of highway and pedestrian traffic, protection of and access to adjacent property, environmental protection, proper disposal of hazardous materials, and furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

## 708 STONE MASONRY

### 708.01 GENERAL

(A) **DESCRIPTION.** This item consists of stone masonry structures, stone masonry facing, and the stone masonry portions of structures, constructed in conformity with the lines, grades and dimensions shown in the contract documents. This item also includes, where applicable, furnishing and installing structure identification emblems.

### (B) DEFINITIONS.

Bed – The top or bottom surface of a stone when in final position.

Depth – The dimension of the stone at right angles to the face of the masonry, measured from the pitch line (not including any rock face projection).

Rise (of a stone) – The dimension of a stone measured normal to the bed pitch line.

Rise (of a course) – The distance between the top bed of a course and the top of the next higher course.

Length – The dimension of a stone measured along the bed pitch line (including any rock face projection).

Face – The exposed surface of a stone.

### 708.02 MATERIALS

All stone shall be durable, sound, of uniform quality and texture, and shall be free from seams and defects which would impair its strength, durability or appearance.

Steel – 815.01(A) or (B)

Galvanizing – 811.07

Caulking compound – 807.02(B)

PCC mortar mix – 806.05(B)

### 708.03 WORKING DRAWINGS AND SUPPLY

(A) **Working Drawings.** The Contractor shall prepare and submit to the Chief Engineer, in accordance with 105.02, working drawings of all Class A (dimensioned) masonry; showing the individual stones in position, their face dimensions, designating marks, and such other detail drawings as are necessary to properly cut and set the work. The drawing shall show all anchors, cramps and dowels.

(B) **Supply.** The Contractor shall submit to the Chief Engineer for approval the names of the quarry or quarries from which the stone is to be obtained, together with evidence that sufficient stone to complete the work is obtainable from the quarry, and that adequate manpower and equipment are available to produce and complete the required amount of stone work within the contract time for completion of the project.

**708.04 SAMPLES AND SAMPLE WALL**

- (A) **Stone Samples.** Before proceeding with the work, the Contractor shall submit for approval by the Chief Engineer the name of the quarry and 2 samples of each kind of stone proposed for use in the work; one sample shall show the lightest color and the other shall show the darkest color of each kind of stone to be furnished. All stone in the work shall be within the color range defined by the approved samples and of the same type of stone. The samples shall have a face size of at least 6 by 6 inches.
- (B) **Sample Wall.** The Contractor will be required to construct a sample wall of the designated class or classes of stone masonry, laid up in mortar and pointed, for approval of the Chief Engineer. Each sample shall show examples of the specified stone finishes, quality of the workmanship in dressing the stone and placing them, and pointing of the beds and joints, and shall be sufficient area to illustrate the distribution of both the coloring and the stone size. The sample wall shall contain at least one edge dressed to show a representative corner. The top shall be dressed to show how the stone will abut the coping. Upon approval of such a sample by the Chief Engineer, it shall become the standard for that class or classes of stone masonry in the entire work. In general, the size of stone masonry sample wall shall not be less than 12 feet long and 6 feet high. However, for copings or other special types or shapes of dimensioned masonry, a short section showing examples of the proposed types of finish may suffice.
- (C) **Payment.** At the option of the Contractor, this wall may be constructed in place as part of the stone masonry called for in the contract documents and if approved, the sample wall shall become part of the completed work and will be paid for as specified herein for the designated class or classes of stone masonry.

**708.05 CLASSES OF STONE MASONRY**

The class of masonry used in each part of the work shall be that shown in the contract documents. Masonry shall be classified as follows:

Class A – Dimensioned ashlar stone masonry composed of stones each of which has two or more fixed dimensions shown on the plans. It is intended for use particularly in arch rings, quoins, pilasters, copings, facing for concrete, parapets, etc.

Class B – Ashlar stone masonry composed of stones shaped, dressed, and set in accordance with certain specified requirements given in the section which set forth the variations allowed in shaping, dressing, setting and coursing the work. It is intended for use in walls, veneer facing, parapets, etc.

Class C – Ashlar stone masonry same as for Class B stone masonry, but less exacting in the variations allowed in shaping, dressing, setting and coursing the work.

Class D – Rubble stone masonry composed of roughly dressed stones set in broken courses. It is intended for use in minor culverts and other similar structures.

**708.06 SIZE OF STONE**

- (A) **Stone Sizes.** Stones, not dimensioned on the plans, shall be furnished in the sizes and face areas necessary to produce the general characteristics and appearance as indicated for the

class of masonry specified. In general, stone sizes shall conform to the following limitations:

- (1) Rise of any stone – 4 inch minimum unless otherwise shown on the plans.
  - (2) Depth of any stone – 6 inch minimum, except as shown on the plans for stone veneer.
  - (3) Length of any stone – 1-1/2 times its rise, minimum; 5 times its rise, maximum; 3 times its rise, average.
- (B) Closure Stones.** Stone sizes shall not include closure stones. A minimum number of closures, not exceeding 5 percent of the exposed surface, may be used only when absolutely necessary. Closures shall be rectangular with their longest face laid horizontal.

### 708.07 FINISH FOR EXPOSED FACES

The kind of finish for the exposed faces of the masonry shall be as specified in the contract documents. Face stones shall be pitched to line along all beds and joints, with no depressions below the pitch line. Each stone shall be out of wind, i.e. the four corners are in the same plane. No drill or quarry marks shall show on the face of any stone. The specified finish shall be in accordance with the following definitions:

- (A) Eight cut. Fine hammered. Interrupted parallel markings not over 3/32 inch apart. A corrugated finish. Smoother near arris lines and on small surfaces.
- (B) Six cut. Medium hammered. Interrupted parallel markings not over 1/8 inch apart. A corrugated finish. Smoother near arris lines and on small surfaces.
- (C) Four cut. Coarse hammered. Interrupted parallel markings not over 7/32 inch apart. A corrugated finish. Smoother near arris lines and on small surfaces.
- (D) Sawn. Fairly plane surface. Varying texture ranging from close approximation to sand rubbed to scorings 3/32 inch in depth. When so specified, scorings shall be vertical or horizontal as produced by gang saws. All exposed surfaces thoroughly sand blasted to remove rust stains and iron particles.
- (E) Sawn and Sanded. Fairly smooth surface. Exposed surfaces cut with a wire saw and abrasive and further treated by sand blasting with new silica sand to blend saw marks into uniform texture.
- (F) Seam Face. The surface shall present a smooth appearance, be free from tool marks, with no depressions below the pitch line and no projected plane exceeding 3/4 inch beyond the pitch line.
- (G) Rock Face. The face shall be an irregular, convex with no concave surfaces below the pitch line, and with projections beyond the pitch line, when measured in inches, not exceeding the figure preceding the symbol as used on the plans e.g., “1-1/2 inch Rock Face” means projections beyond the pitch line not exceeding 1-1/2 inches. Where a variable “rock face” is specified, stones of the same height of projection shall be well distributed.

**708.08 DRESSING STONE**

- (A) **GENERAL.** Stones shall be dressed to remove any thin or weak portions. Face stones shall be dressed to provide bed and joint lines with a maximum variation from true pitch lines as follows:

Class A (Dimensioned) masonry	True
Class B masonry	1/4"
Class C masonry	3/4"
Class D masonry	1-1/2"

All joints shall be vertical, except that splayed joints not greater than 45 degrees will be permitted in Class C and D masonry, with maximum of 10 percent of joints splayed in Class C. Beds shall be horizontal except under copings on a gradient.

Face stone adjoining the edges of exposed concrete work shall be accurately dressed along the edge paralleling the concrete work, allowing sufficient space for pointing.

- (B) **BED SURFACE.** Bed surfaces of face stone shall be normal to the face of the stones for about 50 mm and from this point they may depart from a normal plane not to exceed 25 mm in 300 mm for Class A (dimensioned masonry) and 50 mm in 300 mm for all other classes of masonry.

The corners at the meeting of the bed and joint lines shall not be rounded in excess of the following radii:

Class A (dimensioned) masonry	None
Class B masonry	None
Class C masonry	1"
Class D masonry	1-1/2"

- (C) **JOINT SURFACES (except ring stones).** For all classes of masonry, the joint surface of face stones shall be normal to the face of the stones for about 2 inches, and from this point they may depart from a normal plane not to exceed 2 inches in 12 inches.
- (D) **RING STONE JOINT SURFACES.** Ring stone joint surfaces shall be radial and at right angles to the front face of the stones. They shall be dressed for a distance of at least 3 inches from the front face and the soffits, from which points they may depart from a plane normal to the face not to exceed 3/4 inch in 12 inches. The back surface in contact with the concrete of the arch barrel shall be parallel to the front face and shall be dressed for a distance of 4 inches from the intrados. The top shall be cut of 4 inches from the intrados. The top shall be dressed for a distance of at least 3 inches from the front.

**708.09 ANCHORS**

- (A) **GENERAL.** The Contractor shall furnish and set all anchors, cramps, dovetail slots, dowels, bolts and any other work to the concrete backing. All anchors, cramps,

dowels, bolts, etc. shall be galvanized steel. Any bending shall be done before galvanizing.

- (B) FOR CLASS A MASONRY.** Anchors shall be of 3/8 inch by 1-1/2 inch material and shall extend at least 9 inches into the concrete backing, except where limited by the thickness of the backing, with ends extending not less than 1-1/2 inches vertically into the stone and into the concrete. Cramps for tying stones together shall be of 3/8 inch by 1-1/2 inch material, turned down at least 1-1/2 inches at each end, and shall span at least 12 inches on the flat. In general, 2 anchors shall be used for each stone 1 meter or over in length, and 1 anchor for each smaller stone. Corner stones shall have 1 anchor and shall be cramped to adjoining stones. Special cramps, anchors and/or dowels shall be provided for cap stones, coping stones and other special stones. Each arch ring stone shall be tied to the concrete backing with side anchors, the type and location of which shall be shown in the contract documents.

Holes for anchors, cramps, bolts or dowels shall be at least 150 mm from any face of the stone, except that for stones less than 12 inches in depth, the holes shall be placed at the center of the depth.

Where necessary, stones shall be grooved for cramps and anchors so as to allow at least 1/8 inch for mortar between the cramps or anchors and the adjoining stone.

**(C) FOR CLASS B, C AND D MASONRY**

**(1) MASONRY CONSTRUCTED BEFORE PLACING CONCRETE BACKING.**

Anchors shall be of not less than 8 gage by 1-inch material embedded in the bed joints, spaced 2 feet on centers both horizontally and vertically and shall extend at least 9 inches into the concrete backing and to within 75 mm of the face of the stone. Each end of the anchors shall be of such approved shape and design as to mechanically engage the stone and the concrete backing. The anchor and the methods of anchorage shall be approved by the Chief Engineer before any stone is erected.

**(2) MASONRY CONSTRUCTED AFTER PLACING CONCRETE BACKING.**

Anchors shall be of not less than 8 gage by 1-inch material, embedded in the bed joints and engaging 24 gage dovetail anchor slots in the previously placed concrete. Anchor spacing shall be 2 feet on center, both vertically and horizontally. The end of each anchor embedded in the masonry joint shall be of such approved shape in design as to mechanically engage the stone and shall extend to within 3 inches of the face of the stone. The dovetail anchor slots shall have a temporary filling of felt or other material to prevent the slots from being filled with concrete as the concrete is placed.

During the setting of the stone, the temporary filling shall be removed from the anchor slots and the voids in the anchor slots between the anchors shall be filled with setting mortar. No voids in any part of the wall will be permitted.

**708.10 CONSTRUCTION REQUIREMENTS**

- (A) WEATHER LIMITATIONS.** Stone masonry shall not be placed when the temperature of the air or the stone is below 40°F except by written permission from the Chief

Engineer, and then only by the use of such methods as he may prescribe for preparing the materials and protecting the work after it has been laid. Such permission and the use of the methods prescribed shall not, however, release the Contractor from his obligation to build a satisfactory structure. All work damaged by cold weather shall be removed and replaced.

In hot or dry weather the masonry shall be satisfactorily protected from the sun, and shall be kept wet for a period of at least 3 days after completion.

- (B) LAYING STONE.** All masonry shall be constructed by experienced workmen. Face stones shall be set so as to produce the effect indicated herein for the class of masonry specified and to correspond with the sample wall section approved by the Chief Engineer.
- (1) Beds and Joints.** Beds and joints for Class A masonry shall average  $3/8$  inch, plus or minus  $1/8$  inch. For Class B Masonry, the nominal size of beds and joints shall be  $3/4$  inch; for Class C masonry  $3/4$  to 1 inch; for Class D masonry 1 inch to  $1-1/2$  inches. All joints shall be vertical and shall not extend in an unbroken line through more than 2 stones, except that splayed joints not greater than 45 degrees will be permitted in Class C and D masonry, with maximum of 10 percent of joints splayed in Class C. Beds shall be horizontal except under copings on a gradient, and shall not extend in an unbroken line through more than 4 stones, unless otherwise shown in the contract documents. In no case shall the 4 corners of adjacent stones be contiguous.
  - (2) Bunching.** Care shall be taken to prevent the bunching of small stones or stones of the same size. When weathered or colored stones, or stones of varying texture, are being used, care shall be exercised to distribute the various kinds of stones uniformly throughout the exposed faces of the work. Large stones shall be used for the bottom courses. In general, the stones shall decrease in size from the bottom to the top of the work.
  - (3) Arch Ring Stone.** Arch ring stone shall be carefully thoroughly and wetted immediately before being set, and the bed which is to receive them shall be cleaned and moistened before the mortar is spread.
  - (4) Bedding.** The stone shall be kept free from dirt, oil or any other injurious material which may prevent the proper adhesion of the mortar or detract from the appearance of the exposed surface. Stones shall be laid on their natural beds in full beds of mortar, and the other joints shall be flushed with mortar. The Chief Engineer may direct the lifting and resetting of stones to assure proper bedding.
  - (5) Placement.** The exposed faces of individual stones shall be parallel to the faces of the walls in which the stones are set. The stones shall be so handled as not to jar or displace the stones already set. Suitable equipment shall be provided for setting stones larger than those that can be handled by two men. The rolling or turning of stones on the walls will not be permitted. If a stone is loosened after the mortar has taken initial set, it shall be removed, the mortar cleaned off, and the stone relaid with fresh mortar. All voids between back of stone veneer facing and face of concrete wall, including the voids of anchor slots after removal of the filler material, shall be filled solid with setting mortar. All shaping and dressing of stone shall be done

before the stone is placed, and no dressing or heavy hammering will be permitted after it is placed.

- (6) Spalls. No spalls shall be used in the face of the wall.
  - (7) Cleaning. Immediately after being laid, and while mortar is fresh, all face stone shall be thoroughly cleaned of mortar stains and shall be kept clean until the work is completed. Before final acceptance, if ordered by the Chief Engineer, the surfaces of the masonry shall be cleaned using wire brushes and, if necessary, muriatic acid.
- (C) **MIXING MORTAR.** Before adding water, materials, as described in 806.05(B) shall be mixed, either in a tight box or in an approved mortar mixing machine, until the dry mixture assumes a uniform color. Then the water shall be added as mixing continues. Sufficient water shall be added to produce a mortar of such consistency that it can be handled easily and spread with a trowel. Mortar that is not used within one hour after water has been added shall be discarded. Re-tempering of mortar will not be permitted.
- (D) **POINTING AND FINISHING.**
- (1) Pointing. All beds and joints shall be raked out, before mortar is set, to a depth of not less than 3/4 inch deeper than the surface of the finished joint, then cleaned and pointed with pointing mortar as and when directed by the Chief Engineer. The pointing mortar shall be well driven into the joints with hardwood ramming wedges or other approved method and finished with an approved pointing tool. The stone masonry shall be kept wet while pointing is being done, and in hot or dry weather, the pointed masonry shall be protected from the sun, and kept wet for 24 hours.
  - (2) Finishing. The finishing of all points, beds and joints shall be as shown in the contract documents. For Class B masonry finished beds and joints shall be raked back 3/8 inch from pitch line. When raked beds and joints specified, the mortar shall be raked out squarely to the depth specified. Stone faces in the joint shall be cleaned free of mortar. When weather joints are called for, they shall be weather-struck.
- (E) **BONDING.** Bonding for Class A (dimensioned) masonry shall be as shown on the plans.
- (1) Breaks. All stone, except as shown on the plans, shall be so placed as to break joints at least 4 inches and beds at least 3 inches in order to secure firm bond.
  - (2) Bond with Concrete Surface. Stone surface against which concrete is to be placed shall be thoroughly cleaned to remove all loose materials. Immediately before placing concrete against the masonry, the stone surfaces shall be blown free of dust by compressed air and then thoroughly wetted. The stone surface shall be kept wet at all times at points of spading concrete against them. Spading and vibrating the concrete along the stone surface shall be such as to flush the stone surface with mortar and to completely fill all interstices, securing a firm bond with the stone.
- (F) **BRACING.** When in the opinion of the Chief Engineer the placing of concrete against stone masonry might create pressure sufficient to cause deflection or displacement, the Contractor shall brace the stone masonry in a manner satisfactory to the Chief Engineer.
- (G) **FALSEWORK.** Arch centering shall be designed, submitted for approval and constructed in accordance with 703.16, or as outlined in the contract documents.

- (H) **HEADERS.** When headers are required, they shall be distributed uniformly throughout the wall of structures so as to form at least 1/5 of the faces. Headers shall extend not less than 12 inches into the core or backing, unless otherwise indicated. Headers in walls 2 feet or less in thickness shall extend entirely through the walls.
- (I) **BACKING.** The backing for gravity type walls shall be built primarily with large stones. The individual stones composing the backing and hearting shall be well bonded with the stones in the face wall and with each other. All openings and interstices in the backing shall be completely filled with mortar or with spalls completely surrounded by mortar.
- (J) **PARAPETS.** Selected stone, squared and pitched to line and with heads dressed, shall be used in ends of walls and in all exposed angles and corners. Headers shall be well interlocked and as many as possible shall extend entirely through the wall. Both the headers and stretchers in the two faces of the wall shall be well interlocked in the heart and shall comprise practically the whole volume of the wall. All interstices in the wall shall be completely filled with mortar or spalls completely surrounded with mortar.
- (K) **WEEP HOLES.** All stone walls and abutments shall be provided with weep holes, unless otherwise shown or directed by the Chief Engineer. The weep holes shall be placed at the lowest points where free outlets can be obtained and shall be spaced not more than 10 feet apart. The inlet end of weep holes shall be protected by placing a wire basket 1 foot by 1 foot by 1 foot, filled with coarse aggregate, size 7, 8, 57 or 68 immediately over or behind the holes as directed.
- (L) **EXPANSION OR CONTRACTION JOINTS.** Expansion or contraction joints shall be placed as shown in the contract documents. When caulking is required it shall be applied in accordance with the manufacturer's specifications. The color shall be approved by the Chief Engineer.
- Stone surfaces in contact with expansion or contractions joints shall be neatly squared back from the face of the wall for the full depth of the joints. Preformed joint material shall be anchored to joints by concrete nails at approximately 2 foot intervals.
- (M) **COPINGS, TOP WALLS, BRIDGE SEATS, BACK WALLS, Etc.** Copings, top walls, bridge seats, back walls, etc. shall be constructed to the lines, grades, and cross sections, and of the material, indicated on the contract drawings or as directed by the Chief Engineer.
- (1) **Concrete Copings.** Concrete copings shall be constructed in sections from 5 to 10 feet long and shall be of such width and thickness as indicated on the contract drawings.
- (2) **Stone Copings.** Stone copings shall consist of carefully selected stones of the length, width, and thickness indicated on the contract drawings. They shall have a uniform surface and pitched to line along the top and bottom edge.
- (N) **FOUNDATION PREPARATION.** Structure excavation, foundation preparation, and backfill shall be performed and paid for in accordance with the provisions set out in Division 200. The foundation for this type of construction shall present a uniform bearing surface, and if a reinforced foundation is necessary, it shall be constructed and paid for in accordance with the contract drawings or as directed by the Chief Engineer.

**708.11 REJECTION OF STONE**

Any stone not conforming to the approved sample or not in accordance with the contract documents shall be rejected and removed from the site.

**708.12 MEASURE AND PAYMENT**

The unit of measure for the various classes of Stone Masonry will be the cubic foot. The number of cubic feet of Class A (dimensioned) masonry will be the actual volume of the individual stones determined from the dimensions shown on the approved working drawings. No measurement will be made of mortar backings or mortar joints between the Class A masonry. The number of cubic feet of Class B, C or D stone masonry will be determined from the actual measured length and height of the stone structure and the average depth as indicated in the contract documents.

The volume of joints and beds between Class B, C or D stone masonry and either Class A stone masonry or PCC structures shall be included in the measurement for Classes B, C or D stone masonry. No deductions will be made for openings of less than 2 square feet in area.

The number of cubic feet of Stone Masonry measured will be paid for at the contract unit price per cubic foot for the various classes of Stone Masonry listed in the Schedule of Prices, which payment will include furnishing, cutting and setting of stone, mortar, anchoring devices, furnishing and setting of structure identification emblems, cleaning and pointing, and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

## 709 RAILING

### 709.01 DESCRIPTION

Work shall consist of furnishing, fabricating, preparing, assembling, finishing, and erecting all railings, posts, connections, anchors, and all other work incidental thereto as shown in the contract documents.

### 709.02 MATERIALS

Pipe railing – 809.04 standard weight

Steel for railings – 815.01(A)

Neoprene Pads – 822.02(C)

Galvanizing – 811.07

Steel Anchor Bolts, Nuts, Washers – 815.01(H)

### 709.03 FABRICATION

- (A) **STEEL RAILING.** Bridge railing shall be fabricated to the dimensions shown in the contract documents. Fabrication shall conform to the requirements of 706. Railing shall be galvanized unless otherwise specified in the contract documents.

Loading, transportation, unloading, and field storage of guide rail elements shall be conducted so as to avoid injury and deformation of the railing elements. Damaged pieces shall be repaired or replaced at the Contractor's expense.

Special care shall be exercised and protective shimming, wrapping, or other means shall be employed to protect galvanized surfaces from mechanical damage due to handling, storing, or erecting procedures.

- (B) **PIPE HANDRAIL.** Handrails shall be fabricated to the dimensions as shown in the contract documents. Handrails shall be fabricated by welding all joints. All welded joints shall be welded all around and ground flush with the pipe to present a smooth even finish. Immediately after fabrication the handrail shall be thoroughly cleaned in accordance with 707.06 and given 1 coat of shop paint meeting the requirements of 811.03(A).

### 709.04 ERECTION

#### (A) GENERAL.

- (1) **Anchor Bolts.** Anchor bolts shall be accurately set with suitable rigid templates before placing concrete and shall be in accordance with approved location diagrams prepared by the railing fabricator. Bolts shall be securely fastened to prevent displacement during concreting operations. The anchor bolts shall protrude sufficiently from the surface of the concrete so that when the post is in place all threads of the nut are engaged.
- (2) **Base.** Railing posts and anchor bolts shall be set normal to grade. When post bases are to be set on concrete, the concrete surfaces shall be monolithically finished to

correct elevations and parallel to grade. Building up by grouting under the base shall not be done. Before erection, the areas of concrete upon which posts are to be set shall be dressed by grinding or rubbing to true plane surfaces as to the extent necessary for proper seating to the posts. If the areas of concrete upon which posts are to be set are low, full size shims of the same material as the post shall be used to bring the post to correct elevation. When post bases are to set on stone masonry, full size shims of the same material as the post shall be used to obtain proper alignment. Posts or shims shall be set on a 1/4 inch neoprene pad.

- (3) Alignment. Railing posts and rails shall be erected and carefully aligned before anchor nuts and rail bolts or set screws are tightened. In final adjustment, no post shall deviate more than 1/8 inch from true alignment and there shall be no abrupt breaks in alignment at any location.

**(B) STEEL RAILING.**

- (1) Damaged Pieces. Prior to erection, and after erection, all parts shall be inspected for damage and for chipped or marred coatings. Pieces warped, deformed, or with substantial galvanized areas damaged to bare steel, as determined by the Chief Engineer, will be rejected and the Contractor shall replace such damaged parts with parts meeting these specifications at his sole expense. Marred or chipped areas in the galvanizing such as scratches extending nearly to bare steel, raw edges, spotting, etc., considered to be minor from an aesthetic or corrosion standpoint as determined by the Chief Engineer, shall be properly cleaned and carefully touched up with an zinc rich paint containing not less than 93 percent zinc by weight. The color of the touchup paint shall be a silver-gray which will blend with galvanized surfaces. Yellow-green shades of zinc paint will not be permitted. Surface scratches will not require touchup.
- (2) Alignment. After the railing has been set in place, it shall be adjusted until the top rail is parallel to the curb line of the roadway and has no irregularities apparent to the eye. If the clearance provided by the field holes is inadequate to permit proper adjustment, the field holes shall be reamed in the adjusted position. The adjustment of the railing shall assure that at every post, the top rail shall not depart more than 1/8 inch vertically or horizontally from the required line parallel to the center line of the roadway or to the lines and grades shown in the contract documents. The cost of any necessary adjustment shall be included in the unit price for railing.

**(C) PIPE HANDRAIL.**

- (1) Sleeve Installation. The pipe handrail shall be fastened to the concrete by making provisions at the time of pouring the concrete for steel pipe sleeves, capped at the bottom, of dimensions as shown in the contract documents. These sleeves shall be set vertical, shall be suitably plugged so that concrete and dirt cannot enter the sleeves and shall be checked for plumb position after concrete has been poured and finished.
- (2) Handrail Installation. After the concrete has set, the upright posts of the handrail shall be inserted in the sleeves in a vertical position and braced so that there will be equal clearance all around between pipe and sleeves. Molten lead then shall be carefully poured into the void between pipe and sleeve and allowed to set for 2

hours. After this time if the railing appears securely fastened at all points, bracing may be removed.

- (3) Anchorage to Masonry. Where handrails are to be fastened to a masonry wall, anchorage shall consist of a steel plate fastened to the wall with four expansion bolts as shown on the plans.
- (4) Painting. After the handrail has been erected, it shall be painted in accordance with the requirements of 707 . All painting will be included in the contract unit price for the handrail.

#### **709.05 MEASURE AND PAYMENT**

The unit of measure for the various items of Railing listed in the Schedule of Prices will be the linear foot measured along the railing from out to out of end posts or end details excluding any openings exceeding 6 inches.

The actual number of linear feet furnished and erected, complete in place, will be paid for at the contract unit price per linear foot, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work.

## 710 BRIDGE DECK DRAINAGE

### 710.01 DESCRIPTION

Work consists of furnishing, installing, and painting the scuppers, grates, drainpipe, collector pipe, fittings, hangers, supports and all other materials necessary for the bridge deck drainage system as shown in the Contract Documents.

### 710.02 MATERIALS

Materials shall meet the following requirements:

Scuppers – 815.05

Grates – 815.05

Pipe – 809.01(A)

Pipe Fittings – 809.01(B) (2)

Gaskets – ASTM C 564

### 710.03 CONSTRUCTION REQUIREMENTS

- (A) **SHOP DRAWINGS.** The Contractor shall prepare and submit to the Chief Engineer construction drawings for any deck drainage system in accordance with Section 105.
- (B) **ALIGNMENT.** Scupper surfaces shall conform to grades and lines of the completed structure. Inserts shall be properly spaced for the collector pipe system and hangers adjusted so that the plan grades are secured. Straight pipe shall be in standard uniform lengths. Approved short pipe lengths shall be used where needed to meet line and grade as closure pieces.
- (C) **CUTTING.** When pipe and fittings require cutting, the Contractor shall take field measurements for making, closing and connecting pieces of correct dimension. Cutting shall leave a smooth end.
- (D) **JOINTS.** Joints shall be assembled to insure tight, flexible joints that safely permit movement caused by expansion and contraction. The inside of the socket and the outside of the spigot shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the socket. A thin film of approved gasket lubricant as supplied by the pipe manufacturer shall be applied to either the inside surface of the gasket or to spigot or both. The joint shall then be completed by forcing the spigot to the bottom of the socket with an approved forked tool, jack-type tool or other device. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that spigot is inserted to full depth. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of pipe as manufactured.
- (E) **CONNECTIONS TO EXISTING PIPES.** Prior to making connections to existing pipe the Contractor shall verify the actual size and location of existing pipe in service and provide pipe and fittings with suitable ends or adapters to connect to existing pipe. Limits

of pipe and fittings for this purpose shall be as approved on drawings submitted by the Contractor.

- (F) **PAINTING.** Scuppers and grates shall be shop painted in accordance with 707. After the collector pipe system has been completely installed, it shall be cleaned and painted in conformance with 707 for new metalwork. The color shall be as directed by the Chief Engineer.

**710.04 MEASURE AND PAYMENT**

The unit of measure for Bridge Deck Drainage will be the lump sum. No actual measurements will be made.

Bridge Deck Drainage will be paid for at the contract lump sum price, which payment will include painting, and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

## 711 WALL DRAINS AND CLEANOUTS

### 711.01 DESCRIPTION

Work for wall drains and cleanouts shall include furnishing complete in place: 8 inch diameter perforated vitrified clay or PVC pipe carefully laid and sloped to drain to outlets, 6 inch cast iron or ductile iron pipe risers to cleanouts, 8 inch diameter cast iron or ductile iron sewer connect pipe, pipe fittings, cleanout boxes and covers, and the connection to the sewer system in the locations and as shown in the contract documents.

### 711.02 MATERIALS

Pervious backfill – 805.02

Perforated pipe – 808.03, Class 3 or 808.02(B)

Mortar – 806.05(B)(4)

Cast iron pipe – 809.03

Ductile iron pipe – 809.01

Pipe fittings – 809.01(B)(2)

### 711.03 CONSTRUCTION REQUIREMENTS

- (A) **GENERAL.** Abutments and walls shall first be backfilled to a line approximately 6 inches below the bottom of the wall drainpipe. A minimum of 6 inches of pervious backfill shall be provided around the pipe. The pipe shall be carefully laid with perforations down.

Each section of the pipe shall have a firm bearing throughout its length and be true to the line and grade required. Wall drains shall be kept free from accumulations of silt, debris and other foreign matter during their construction and shall be free of such accumulations at the time of their final acceptance. Prior to final acceptance the Chief Engineer may require that the drain system be checked by flushing water from a hose inserted into the cleanout, through the system. In the absence of a clear flow at the discharge end, the Chief Engineer shall require replacement of that part of the system not functioning properly. All junctions, including connections with existing sewers, shall be made with regular wye connections and sharp turns shall be made with elbows.

The connection of the sewer connection pipe to the sewer structure shall be as directed by the Chief Engineer.

### (B) JOINTS.

- (1) **PVC PIPE.** Adhesive formulated for joining PVC pipe shall be approved by the Chief Engineer prior to use. Adhesive shall be applied so that the entire contact surfaces of adjoining pipes are coated. Adhesive shall be allowed 4 hours to set before commencing backfill unless otherwise indicated by the manufacturer.
- (2) **IRON PIPE.** Joints for iron pipe shall be as specified in 710.03.

**711.04 MEASURE AND PAYMENT**

The unit of measure of Wall Drains and Cleanouts will be the lump sum. Payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.

## 712 GLAZED CERAMIC TILE

### 712.01 DESCRIPTION

This work shall consist of a mortar scratch coat applied directly to the concrete walls, ceilings and columns, a mortar float coat applied upon the mortar scratch coat and a facing of individual glazed ceramic tiles embedded in a freshly placed float coat.

### 712.02 MATERIALS

Glazed Ceramic Tile – 806.04

Mortar Mixtures – 806.05(B)(3)

Tile Joint Sealant – 807.07

The Contractor shall provide approved equipment for checking tiles for warpage, wedging and size. The equipment shall mechanically measure compliance or non-compliance of the tiles with the specified limits of warpage and wedging and shall classify the tiles as to size group.

### 712.03 CONSTRUCTION REQUIREMENTS

- (A) **GENERAL.** No mortar or tiles shall be placed until all backfilling over tunnels, behind walls, etc., has been placed, compacted and approved by the Chief Engineer. Placing of mortar or tiles shall not be permitted when the ambient temperature is less than 50°F. If the ambient temperature is expected to fall below 50°F following placement of any mortar or tiles, the Contractor shall furnish sufficient protection of the work and necessary heating devices to maintain a minimum ambient temperature of 50°F for a period of 7 days following placement of the mortar or tile.

During hot weather, the Contractor shall furnish necessary protection for all tile work against sun and wind, such as wind breaks, polyethylene cover or waterproof paper. Moistening by fog spraying or sponging may also be required.

The tile shall be delivered to the project in the original sealed containers, each container to be clearly marked as to color, finish, size, shape and quantity. Tile shall be stored on pallets.

The Contractor shall determine the actual sizes and locations of all air port openings, door openings, niches, expansion joints and similar features. These features may not be of the same size or locations shown on the plans and may be out of plumb or out of square. The Contractor shall neatly cut and fit tile bull noses of such features. No additional payment will be made because of these features varying from the plans or because they may be out of plumb or out of square.

### (B) MORTAR.

#### (1) MIXING MORTAR.

Mortar may be either machine mixed or mixed by hand. The portland cement and sand shall be thoroughly mixed dry after which sufficient water and lime shall be added to produce a stiff mix. Mortar shall be freshly mixed for prompt use and no mortar shall be used that has been mixed beyond the time limit as directed by the Chief Engineer.

Re-tempering of mortar shall not be permitted under any circumstances. The use of chemicals in the mortar to prevent freezing shall not be permitted.

The mixing machine, size of batch and mixing time will be approved by the Chief Engineer. When hand mixing is used, the mixing shall be accomplished in a clean, leak-proof mortar box constructed specifically for that purpose.

**(2) APPLYING MORTAR.**

The concrete surfaces on which the mortar scratch coat is to be placed shall be thoroughly cleaned by water at 200 psi minimum pressure or by other methods satisfactory to the Chief Engineer. After cleaning, the surfaces shall be dampened, but not saturated, with water and a neat portland cement wash applied immediately before placing the mortar scratch coat. The portland cement wash shall consist of 7 gallons of water per bag of cement and shall be used within 6 hours after mixing.

The scratch coat shall be trowelled to an even surface, parallel to and not more than 3/8 inch from the back surface of the body of the tile, exclusive of the lugs and keys. Where, due to irregularities in the concrete surfaces, the scratch coat requires a thickness of more than 1/2 inch, the scratch coat shall be built up in two or more coats; the initial coat shall have a maximum thickness of 1/2 inch and each subsequent coat shall have a maximum thickness of 3/8 inch. Wherever more than one scratch coat is necessary, the surface of each coat shall be scored before hardening and dampened immediately before application of the next coat. The surface irregularities of the final scratch coat shall not exceed 1/4 inch in a length of 10 feet. The final scratch coat, while still plastic, shall be deeply scored or scratched horizontally and diagonally with marks about 1/2 inch apart.

After the scratch coat has been completed and cured at least 24 hours, the float coat shall be applied within a period of 72 hours after curing of the scratch coat. Before the float coat is applied, the scratch coat shall be cleaned where necessary, and thoroughly moistened, but not saturated with water. Screeds or temporary guide strips shall be mortared to the scratch coat to indicate accurately the surface planes of the float coat. The thickness of the float coat shall not exceed 3/8 inch. The float coat shall be well rodded and floated to a true surface parallel to the finished surface of the wall and shall be applied only in such quantities as can be covered with tile before the initial set of the mortar as directed.

**(3) SETTING TILE.**

All tile shall be thoroughly sprayed with or immersed in clean water prior to setting. Immediately after placing the float coat, a skim coat of neat cement, not exceeding 1/8 inch thickness, shall be applied uniformly to the back of each tile so as to completely fill all spaces between lugs or keys and present an even plane surface. Each tile shall be tapped firmly into place and brought flush with adjacent units. Lines shall be kept straight and all finished surfaces shall be true. Broken, cracked, marred, or other defective tiles shall be replaced before the mortar has set.

Wherever there is a change in direction of the tile facing, all corners, coves, angles, combinations, or other trimmer tile shall be furnished and installed as required.

The tile shall fit neatly around all wall niches, openings, and horizontal and vertical expansion joints. The Contractor shall do all field cutting and drilling required for

the installation of the tile. So far as practicable, all cutting shall be done by power saws, and the cut edges shall be smooth and straight and free from chipping. Hand-cut tile shall be filed or ground smooth on the cut edges.

Each graded size or lot of tile shall be set in separate segregated groups or areas extending for the full height of the walls or columns, and for the full width of the ceilings. The size of tile in adjoining groups shall not vary by more than 1/32 inch.

Joints in the tile facing of the walls, ceiling and columns shall be constructed as specified herein and as shown on the plans, using approved spacing gauges or devices. Expansion joints shall be constructed directly over all expansion joints in the concrete masonry and where the tile abuts another material. If the joints in the concrete masonry are spaced greater than 16 feet, either vertically or horizontally, small relieving joints equal to a normal tile joint width (approximately 1/8 inch) shall be provided at intervals of 12 to 16 feet but not to exceed 16 feet, and shall be sealed with materials conforming to the requirements of 807.07. Joints shall be carried through all mortar coats and the tile surface, at the same width as the width of the joint in the concrete masonry.

After the mortar has hardened sufficiently to hold the tile firmly in place, loose mortar shall be raked out and the faces of the surface shall be thoroughly washed clean with water, and while still moist, the joints between the tile shall be grouted with white portland cement combined with sufficient water to obtain a consistency of thick cream. The grout shall be forced into the joints by troweling or other approved method, and finished straight and true. Special care shall be taken to prevent the scratching of the glaze on the face of the tile. Prior to hardening, any excess grouting shall be washed off with a sponge and water leaving all joints full, smooth, and flush with the cushion edge of the tile, and the face of the tile clean. Remixing or use of grout that has partially hardened will not be permitted.

As the work of setting tile progresses, the Contractor shall remove all unused material and debris and shall give the tile work a thorough cleaning with water and cloths. All traces of cement or dust accumulation shall be completely removed. No acid solution will be allowed, under any conditions, for cleaning tile surfaces. The Contractor shall take such precautions as may be necessary to prevent the soiling or injury of the tile work during the remainder of the project, and shall clean or replace any tile that may become soiled or injured. Before final payment is made, all imperfect, loose, or misplaced tile shall be removed by the Contractor at his own cost and expense, and replaced with approved units.

The Contractor shall clean and remove all stains, oil, dust, grease, and marks from the walls and repair any defective joints or fixtures prior to final acceptance of the wall tile.

#### **712.04 MEASURE AND PAYMENT**

##### **(A) MORTAR SCRATCH COAT FOR TILE.**

The measure for Mortar Scratch Coat For Tile will be the square foot. The quantity to be paid for will be the number of square feet of mortar scratch coat actually placed and

accepted by the Chief Engineer, measured on the exposed surface of the mortar with no deduction for areas one square foot or less for outlets for mechanical or other fixtures.

Payment will be made at the contract unit price per square foot bid in the Schedule of Prices, which payment shall constitute full compensation for the furnishing of all materials, labor, tools, equipment, neat coat of cement, scaffolding, and incidentals necessary to complete this item of work.

**(B) GLAZED CERAMIC TILE.**

The measure for Glazed Ceramic Tile for Walls and Glazed Ceramic Tile for Ceilings will be the square foot. The quantity to be paid for will be the number of square feet, as indicated on the plans, actually placed, and accepted by the Chief Engineer, measured on the exposed surface of the tile with no deduction for areas one square foot or less for outlets for mechanical or other fixtures.

Payment will be made at the contract unit price per square foot, which payment shall constitute full compensation for the furnishing of all materials, labor, tools, equipment, mortar float coat, neat cement skim coat, grout, elastic joint sealing materials, scaffolding, cleaning and incidentals necessary to complete this item of work.

## 713 STEEL SIGN STRUCTURES

### 713.01 DESCRIPTION

Work consists of furnishing, fabricating, galvanizing and erecting sign structures including horizontal trusses, maintenance catwalks, upright supports, base plates, and anchor bolts, as required in the contracts document and/or as directed.

Work also includes replacement of damaged pieces.

### 713.02 MATERIALS

Materials for Steel Sign Structures – 824.03

Self-Anchoring Bolts per FSS-FF-S-325 for Group I, Type 2, Styles 1 and 2; Group II, Type 4, Class 1 and 2; or Group III, Types 1 and 2. Bolts shall be galvanized per 811.07 and be capable of withstanding a proof test load 4 times greater than design working load.

Epoxy Adhesive and Mortar per 822.08(B) and 806.05(C).

### 713.03 MILL AND SHOP PROCEDURES

Requirements of AASHTO M 160 shall be met at all times.

The Contractor shall verify all horizontal dimensions of the overhead truss sign structure span length before fabrication. Span lengths shown on plans are approximate only. All horizontal trusses shall be cambered to compensate for dead load deflections and to overcome the illusion of sag. Each truss shall be checked in the shop for alignment, sound welds and general workmanship.

The Contractor shall take the necessary steps to insure that errors, defects, omissions, unauthorized corrections made by flame cutting or grinding, defectively driven rivets, etc., are caught and corrected by acceptable methods at the earliest stage practicable.

The Contractor also shall make provisions to furnish and maintain at both the steel mill and fabrication shop, adequate space with drawing table, light and a telephone for the exclusive use of personnel performing mill and shop inspection for the District.

For rejected work and material under mill, shop and job site inspection, one reinspection for each instance of corrective action will be allowed at no cost to the Contractor. All costs associated with further re-inspection will be paid by the Contractor.

### 713.04 WELDING

Welding procedures will conform to 706.18, and/or as specified herein.

When evidence of record is accepted in lieu of required tests, the Contractor shall furnish the manufacturer's certification that the filler metal and shielding being used on the project were manufactured with the same material and process requirements as the filler metal and shielding used for the evidence of record procedure.

After welding has been completed and prior to galvanizing the assembly, mating surfaces of arm flange plates must meet the flatness requirements of AASHTO M 160.

### **713.05 TRANSPORTATION AND FIELD STORAGE**

Loading, transportation, unloading and field storage of fabricated and rolled material shall be conducted so as to avoid injury and deformation of the metal. Damaged material shall be repaired or replaced by the Contractor at his expense, as determined by the Chief Engineer.

Special care shall be exercised and protective shimming, wrapping or other means employed to protect galvanized surfaces from mechanical damage due to handling, storage or erection procedures.

Marred or chipped areas in the galvanizing such as scratches, extending nearly to bare steel, raw edges, spotting, etc., considered to be minor from aesthetic or corrosion standpoint as determined by the shall be properly cleaned and carefully touched-up with a zinc rich paint, the delivered paint containing not less than 93 percent zinc by weight. Color of touch-up paint shall be a silver gray which will blend with galvanized surfaces. Yellow-green shades of zinc paint will not be permitted. Fines scratches, however, will not require touch-up.

### **713.06 ERECTION METHODS**

Sign structures shall not be erected until the support footings have cured and are properly backfilled. Before erection, bottom surfaces of base plates shall be given a pretreatment wash of either cold phosphate pretreatment or basic zinc-chromate- vinyl butyral wash coat and two field coats of primer per FSS TT-P-641, Type II.

Field drilling of holes in any part of sign structures is prohibited.

Upright sign structure members shall be erected truly vertical with the tops of each installation at the same elevation. Upright members shall be plumbed and brought to final grade by means of leveling nuts on the anchor bolts.

Horizontal cross members shall be erected so that beam clamps on each upright are at the same elevation; members shall be cambered to insure that after placement of signs, cross members will not appear to deflect below the horizontal. Horizontal cross members shall be erected at the proper height to insure that after placement of the sign, required minimum clearance between bottom of sign panel, sign light support or catwalk support, and highest point of roadway is provided.

After each overhead structure has been properly erected, grout meeting the requirements of 806.05(E) shall be placed to completely fill the space under support base plates. Grout shall be neatly finished with beveled surfaces.

Grout shall contain no more water than needed to produce a workable, plastic mix.

### **713.07 ERECTION ON EXISTING STRUCTURES**

Where it is necessary to attach a sign or sign support to an existing bridge or retaining wall, care shall be taken to prevent damage to the existing structure. All areas damaged as a result of Contractor operations shall be acceptably restored to their original condition by the Contractor at Contractor expense.

Bolt installation may be made at a temperature not lower than 35°F and only when temperature during cure period will not drop below 25°F.

**(A) DRILLED ANCHOR HOLES.** Anchor bolts shall be set in drilled holes.

Drilled anchor bolts holes shall be at least 1 inch larger in diameter than the bolts used. Holes shall be drilled in PCC and/or stone masonry to depth needed for proper anchorage.

Work includes cutting through reinforcing steel, if any, and use of diamond bits or other procedure to properly drill holes, plus repair of damage to anchorage area. Drilling templates shall be used to insure aligned holes. Holes shall be washed out to remove all residue, dried out, and bolts promptly mortared in the holes. Holes shall be protected from frost action.

**(B) EPOXY-ANCHORED BOLTS.** Bolts shall be clean and degreased with toluene.

Bolts may be installed by either: (1) pouring epoxy mortar to a predetermined level in the hole, then inserting bolt and working it up and down plus tapping lightly to insure embedment; or (2) inserting bolt and pouring epoxy mortar into the entire annular space between bolt and hole.

With either method, templates shall be used to secure bolts in proper position until the mortar cures.

**(C) SELF-ANCHORING BOLTS.** Self-anchoring bolt installations shall be made in holes drilled to proper dimensions to accommodate the type of self-anchoring bolt being used.

Self-anchoring bolts shall be inserted according to the manufacturer's recommendations.

### **713.08 MEASURE AND PAYMENT**

The unit of measure for Steel Sign Structures will be the job, complete in place.

Payment for Steel Sign Structures will be made at the contract lump sum price for each sign structure, which payment will include furnishing anchorage units complete, drilled anchorages complete, grouting, galvanizing, base plate painting and all labor, tools, material, equipment and incidentals needed to complete specified work.

The Contractor also shall have bid a unit price per pound for Steel Sign Structures, which price will become the contract unit price for "adds" and "deducts" required and approved by the Chief Engineer due to field conditions, changes, etc.

**714 BRIDGE DECK CONCRETE OVERLAYS****714.01 DESCRIPTION**

This work shall consist of placing various concrete overlays as a wearing surface on bridge decks, to the prescribed depth and to the lines and grades shown on the contract plans and as specified herein.

**714.02 LOW SLUMP CONCRETE OVERLAY**

(A) **General** – This work shall consist of placing a low slump concrete wearing surface on bridge decks, to the prescribed depth and to the lines and grades shown on the plans and as specified herein. Also included shall be removal and disposal of existing asphalt overlay and waterproofing membrane, if present, and between a 1/4” to 1/2” thickness of concrete from the top of existing deck slabs.

**(B) Materials.**

- (1) Portland Cement Concrete – 817, Class I. High early strength cement shall not be permitted.
- (2) Fine Aggregate – 803.01.
- (3) Coarse Aggregate – Coarse aggregate shall be a crushed trap stone as specified in 803.02, except that the grading shall be Size No. 78 as specified in AASHTO M 43.
- (4) Water – 822.01.
- (5) Bonding Agent – Grout for bonding the low slump concrete to previously placed concrete shall consist of equal parts by weight of Portland cement and sand mixed with sufficient water to form stiff slurry that will not run or puddle in low spots. For sealing vertical joints between adjacent lanes and at curbs, this grout shall be thinned to paint consistency.

**(C) Equipment.**

- (1) General – Equipment used shall be subject to the approval of the Chief Engineer and in conformance to the requirements of Division 900, where applicable, except concrete spreading and finishing machines. The finishing machine shall be inspected and approved by the Chief Engineer before work is started. A mechanical strike-off shall be required to provide a uniform thickness of concrete in front of the oscillating screed.
- (2) Screed Machine – At least one oscillating screed shall be designed to consolidate the concrete to 100 percent of the unit weight, determined in accordance with ASTM C 138-71T, by vibration. A sufficient number of identical vibrators shall be effectively installed such that at least one vibrator is provided for each 5 feet of screed length. The bottom face of this screed shall be at least 5 inches wide with a turned up or rounded leading edge to minimize tearing of the surface of the plastic concrete. Each screed shall have an effective weight of at least seventy-five pounds for each square foot of bottom face area. Each screed shall be provided with positive control of the vertical position, the angle of tilt, and the shape of the crown. Design of the finishing machine together with appurtenant equipment shall be such that positive

machine screeding of the plastic concrete will be obtained within one inch of the face of existing curbs. The length of the screed shall be sufficient to extend at least 6 inches beyond the line where a saw cut is intended to form the edge of a subsequent placement section, and shall overlap the sawn edge of a previously placed course at least 6 inches. Provision shall be made for raising the screeds to clear the screeded surface for traveling in reverse.

- (3) Rails – Supporting rails upon which the finishing machine travels will be required on all surfacing projects. The support for these rails shall be fully adjustable (not shimmed) to obtain the correct profile. When placing concrete in a lane abutting a previously completed lane, that side of finishing machine adjacent to the completed lane shall be equipped to travel on the completed lane.

**(D) Construction Requirements.**

- (1) Surface Preparation – Work on the surface shall not commence until the lower course meets the compressive strength of 4,500 psi on field test cylinders made in the field and cured in the laboratory but not less than 7 days after placement. The entire surface of the newly placed concrete floor shall be sandblasted to remove all dirt, oil and other foreign material as well as any laitance followed by oil-free, dry air cleaning. Curbs, sidewalks, concrete and/or metal barrier railings, hand railing, etc., shall be protected from the sandblasting. Grout shall be applied on this cleaned, dry surface by brushing on a thin and even coat, then immediately followed by placing and finishing a low slump concrete. The rate of progress in applying grout shall be limited so that the grout does not become dry before it is covered with new concrete.
- (2) Placement – The placement of the concrete shall be a continuous operation. The new concrete shall be manipulated and mechanically struck off slightly above final grade. It shall then be mechanically consolidated to 100 percent of the rodded unit weight with minus 2 percent tolerance. The rodded unit weight will be determined in accordance with ASTM C 138-71T. The elapsed time between depositing the concrete on the floor and final screeding shall not exceed 10 minutes.
- (3) Joints – At transverse and longitudinal joints, the surface course previously placed shall be sawn to a straight and vertical edge before the adjacent surface course is placed. No edges shall be chipped. Concrete shall not be placed adjacent to a surface course less than 36 hours old except to a continuation of placement of a lane or strip beyond a joint in the same lane or strip. As soon as finishing has been completed, all vertical joints with adjacent concrete shall be sealed by painting with thinned grout.
- (4) Texture – When a tight, uniform surface has been achieved the surface shall be textured with metal tines as described in 905.09(F).
- (5) Curing – The surface shall then be immediately covered with wet burlap meeting the requirements specified in 814.01. Curing shall be done in the manner described in 703.18, except that the burlap shall be kept constantly wet for 72 continuous hours instead of seven days.
- (6) Temperature – The PCC Surface mixture shall not be placed at temperatures lower than 45°F. It may be placed at 45°F when rising temperatures are predicted and then only if and until the prediction indicates 8 hours over 45°F for the curing period. At

temperatures above 85°F, the Chief Engineer may require placements to be made at night or early morning hours, if in his opinion a satisfactory surface finish is not being achieved.

### 714.03 LATEX-MODIFIED CONCRETE OVERLAY

(A) **General** – This work shall consist of placing a one course, latex modified concrete overlay on bridge decks, to the prescribed depth and to the lines and grades shown on the plans and as specified herein. Also included shall be removal and disposal of existing asphalt overlay and waterproofing membrane, if present, and between a 1/4” to 1/2” thickness of concrete from the top of existing deck slabs.

(B) **Materials** – Materials and their use shall conform to the following requirements:

- (1) Portland Cement Concrete – 817, Class J. High early strength cement shall not be permitted.
- (2) Fine Aggregate – 803.01.
- (3) Coarse Aggregate – Coarse aggregate shall be a crushed trap stone as specified in 803.02, except that the grading shall be Size No. 7 as specified in AASHTO M 43.
- (4) Water – 822.01.
- (5) Latex Admixture – The formulated latex admixture shall be Dow SM-100 Modifier A, Tylac 97-314 (Thermoflex 8002), Polysar 1186 or Deco-Rez 4776. A manufacturer’s certification shall accompany these products stating that the latex being supplied is of identical formulation to that supplied to the FHWA Turner-Fairbanks Highway Research Station for initial approval.

Other Styrene-Butadiene latex admixtures may be used provided they have been tested in accordance with and meet the acceptable criteria of the testing program outlined in Report No. FHWA-RD-78-35 of the Federal Highway Administration.

Each shipment of latex admixture shall be accompanied by a report of tests performed in accordance with the Certification Program found in Section VII of Report No. FHWA-RD-78-35. In addition to the actual test results, the report shall include the date of manufacture, batch or lot number(s), quantity represented, manufacturer’s name, place of manufacture, a statement that all test results are satisfactory and the date on which the one year certification will expire.

The latex admixture shall be packaged and stored in containers and storage facilities which will protect the material from freezing and from temperatures above 85°F. Additionally, the material shall not be stored in direct sunlight and shall be shaded when stored outside buildings during moderate temperatures. Any latex admixture which has been exposed to freezing temperatures shall not be used.

- (6) Latex Modified Concrete Mix Design – Latex concrete shall meet the following requirements:

**Material or Property**

Cement Content, bags/C.Y.

Latex Emulsion Admixture

**Modified Concrete**

7.0

Modifier, gal./bag	3.5
Air Content, % of plastic mix	7.5 or less
Water/Cement ratio including water in latex emulsion, max.	0.40
*Slump, inches	4-6
Percent Fine Aggregates as percent of total aggregate by weight	50-60
**Strength, psi	4000 in 28 days

Notes: \* The slump shall be measured 4 to 5 minutes after discharge from the mixer. During this waiting period, it shall be deposited on the deck on a suitable container and not be disturbed. Care shall be exercised to ensure that traffic vibrations do not affect the measurement.

\*\* 6"x 12" cylinders shall be wet cured for 24 hours, stripped and air cured before testing.

(C) **Equipment** – All equipment for the deck preparation, mixing, placing and finishing of latex modified concrete shall be approved by the Chief Engineer prior to the start of any work. A standby mobile mixer shall be on the site during the entire mixing operation.

(1) **Proportioning and Mixing Equipment** – Proportioning and mixing equipment shall be a self-contained, mobile, continuous mixer subject to the following requirements:

- (a) **Mixing Unit** – The mixing unit shall have a metal plate or plates permanently attached in a prominent place on which are plainly marked the gross volume of the unit in terms of mixed concrete, operating speed, auger mixing angle and the weight-calibrated cement constant of the machine in terms of a revolution counter or other output indicator, all as rated by the manufacturer.
- (b) **Compartments** – Separate compartments shall be provided to carry the necessary ingredients needed for the manufacture of latex modified concrete. Aggregate bins shall be covered at all times. The cement bins shall be free of moisture and contamination at all times. Suitable means as approved by the Chief Engineer shall be provided to carry water and additives on the truck and to incorporate the additives with the mixing water in the mix.
- (c) **Feed Systems** – The unit shall have a feeder system mounted under the compartment bins to deliver the ingredients to the mixing unit. Each bin shall have an accurately controlled, individual gate to form an orifice for volumetrically measuring the material drawn from each respective bin compartment. The cement bin feeding mechanism shall be set to discharge continuously at a uniform rate, a given volumetric weight equivalent of cement during the mixing operation. The fine aggregate feeding mechanisms shall be coordinated with the cement feeding mechanisms to deliver the required proportions.
- (d) **Mixer Unit** – The mixer unit shall be an auger type mixer incorporated into the truck's discharge chute or other suitable mixing mechanism approved by the Chief Engineer and shall produce concrete of uniform consistency and discharge the mix without segregation.

- (e) **Dials and Measuring Devices** – The unit shall be equipped with an accurate revolution counter indicator permitting the reading of the volumetric weight equivalent of cement discharge during the concrete mixing operation. The counter shall be equipped with a ticket printout to record this quantity. A fine aggregate dial shall permit the setting of of required openings for volumetric proportioning of aggregates.

The unit shall be equipped with a water flow meter or gauge to indicate the discharge rate of water by volume entering the mix. The water and additive measuring devices shall be coordinated with the cement and aggregate feeding mechanisms. The flow meters shall be equipped with scales commensurate with the type and amount of material being added.

A tachometer to indicate the drive shaft speed shall be mounted on the unit. All indicating devices that bear on the accuracy of proportioning and mixing of concrete shall be in full view and near enough to be accurately read or readjusted by the operator while concrete is being produced. The operator shall have convenient access to all controls.

- (f) **Calibration** – The unit shall be constructed to permit convenient calibration of the gate openings and meters. The calibration shall be conducted at least once a year by the manufacturer of the concrete in the presence of DCDOT representatives. The manufacturer of the concrete shall make satisfactory arrangements with the Chief Engineer at least one week in advance of calibration.

Recalibration shall be conducted in the event of a change in the source of fine aggregate. Additional calibrations shall be conducted when deemed necessary by the Chief Engineer. Each unit approved by the Chief Engineer shall carry a copy of the calibration certification.

Certification of the calibration by an approved testing authority will be accepted as evidence of this accuracy if the yield is shown to be true with a tolerance of 1.0 percent according to the following test:

With the cement meter set on zero and all controls set for the desired mix, activate the mixer, discharging mixed material into a one quarter cubic yard container, 36"x36"x9". When the container is level struck full, making provisions for settling the material into all corners, the cement meter must show a discharge of 2 bags of cement for modified mortar (8 bags/c.y. mix).

- (g) **Mixing and Delivery Control** – Cement and aggregate shall be proportioned, measured and batched by the volumetric equivalent method. In the operation, the entire measuring and batching mechanism must produce the specific proportions of each ingredient. Tolerances in proportioning the various ingredients shall be as follows:

Cement, weight percent	0 to +4
Fine Aggregate, weight percent	2
Water, weight or volume percent	1

Latex, weight or volume percent . 2

The tolerances are based on a volume/weight relationship established during the calibration of the measuring devices. During mixing, the driveshaft speed as indicated by the tachometer shall be maintained at the operating speed 50 RPM. The auger mixing angle shall be set in the range determined by the manufacturer. The interval between the continuous placing of succeeding batches shall not exceed 30 minutes. The mixer shall be equipped to spray water over the entire placement width as it moves ahead to ensure that the surface to be overlaid is wetted prior to receiving the modified material.

- (2) Placing and Finishing Equipment – An approved finishing machine, meeting the requirements of 905.06(B), shall be used for finishing all large areas of work. The finishing machine shall be self-propelled and capable of forward and reverse movement under positive control. Provisions shall be made for raising all screeds to clear the screeded surface for traveling in reverse.

The machine may also be of the vibrating screed type designed to consolidate the modified composition by vibration. The vibration frequency shall be variable with positive control between 3000 and 11,000 vpm. The bottom face of the screeds shall be not less than 4 inches wide and shall be metal covered. The screeds shall be provided with positive control of the vertical position. Screed rails shall be constructed of 1/2" bar stock not less than 2 inches wide, drilled and countersunk for attachment to the prepared surface. A suitable portable lightweight or wheeled work bridge shall be required and used behind the finishing operation.

Placing and finishing equipment shall include hand tools, meeting the requirements of 905.09, for placement and brushing in freshly mixed modified concrete and for distributing it to approximately the correct level for striking off with the screed. Approved hand-operated vibrators and screeds shall be used to place and finish small areas of work.

#### **(D) Construction Requirements**

- (1) Surface Preparation – Not more than 24 hours prior to placement of the latex modified concrete overlay, the entire surface of the deck shall be sandblasted to remove all laitance, dirt, oil and other foreign material followed by an air blast cleaning using compressed air with a high velocity nozzle. The edges of previously placed lanes of over layment shall be sandblasted to remove the trowel cut surfacing and promote bond. If necessary, detergent cleaning, followed by sandblasting and air blast cleaning shall be required. Immediately prior to placement of latex modified concrete, the clean surface shall be thoroughly wetted for a period of not less than one hour. Any standing water in depressions or holes in the areas of concrete removal shall be blown out with compressed air.

To insure bonding, paste from the Latex Modified Concrete shall be broomed into the surface of the substrate concrete. The excess aggregate left after brooming shall not be mixed back into the LMC and shall be discarded. The brooming, placement, and seceding operations shall be continuous and completed within 10 to 15 minutes.

- (2) Placing and Finishing – Anchorages for supporting rails shall provide horizontal and vertical stability. Screed rails shall not be treated with parting compound to facilitate their removal.

The admixture shall be placed and struck off to approximately 1/4" above final grade. It shall then be consolidated and finished at final grade with the vibrating devices. Spud vibration shall be used at the edges and adjacent to joint bulkheads. Hand finishing with a float may be required along the edge of the placement or on small areas of repair. Edge tooling shall be required at joints, except next to metal expansion dams, curbs and previously placed lanes.

Screed rails and/or construction bulkheads shall be separated from the newly placed material by passing a pointing trowel along their inside face. Metal expansion dams shall not be separated from the over layment. Care shall be exercised to ensure that this trowel cut is made for the entire depth and length of rails after the mixture has stiffened sufficiently.

The surface shall be promptly covered with a single layer of clean wet burlap as soon as the surface will support it without deformation. Within one hour of covering with wet burlap, a layer of 4 mil polyethylene film shall be placed on the wet burlap and the surface cured for 24 hours. The curing material shall then be removed for an additional 72 hour air cure. Wet burlap-polyethylene sheets may be substituted for the polyethylene film with the approval of the Chief Engineer, but shall not replace the initial wet burlap application.

When the latex modified overlay has been cured, it shall be textured in accordance with the requirements of 703.21(C).

- (3) Limitation of Operations – No vehicular traffic shall be permitted on the latex concrete surface until 120 hours after placement. At temperatures below 55°F, the Chief Engineer may require a longer curing period.

The latex modified mixture shall not be placed at temperatures below 45°F. It may be placed at 45°F when rising temperatures are predicted and then only if and until the prediction indicates a temperature of over 45°F during the initial 8 hours of the curing period. At temperatures above 85°F, the Chief Engineer may require placements to be made at night or early morning hours if in his opinion a satisfactory surface finish is not being achieved.

A construction dam or bulkhead shall be installed in case of a major delay in the placement operation resulting in the formation of the plastic film. During minor delays, the placement shall be protected from drying with several layers of wet burlap.

Adequate precautions shall be taken to protect freshly placed modified concrete from sudden or unexpected rain. All placing operations shall stop when rain begins. The Chief Engineer may order removal of any material damaged by rainfall.

- (4) Application of Live Loads – Truck mixers and other heavy equipment shall not be permitted on the latex modified concrete overlay, nor shall the traveling public, until authorized by the Chief Engineer. Such authorization may only be given after the prescribed curing period has taken place, after the last concrete has been placed, and

providing that the concrete placed on the deck has attained a minimum strength of 3500 psi. Specimens shall be cured in the same manner the deck is cured.

#### 714.04 MICROSILICA CONCRETE OVERLAY

(A) **General** – This work shall consist of placing a one course, microsilica concrete overlay on bridge decks, to the prescribed depth and to the lines and grades shown on the plans and as specified herein. Also included shall be removal and disposal of existing asphalt overlay and waterproofing membrane, if present, and between a 1/4" to 1/2" thickness of concrete from the top of existing deck slabs.

#### (B) Materials.

(1) Concrete – The concrete for PCC overlay including filling depressions created by removal of concrete, shall conform to 703 except for the following modifications:

Portland Cement	635 lb/cy
Water(Cement+Silica Fume)Ratio	0.40 (max.)
Slump	6 + 2 in.
Air Content	7 + 2 percent
Silica Fume	8 to 10% (Solids) by weight of cement added as admixture in slurry form
Synthetic Fiber	1 lb.
Compressive Strength	4500 psi @ 28 days

(2) Silica Fume – Silica Fume shall conform to the following chemical and physical requirements:

Silicon Dioxide (SiO <sub>2</sub> ),min %	85.0
Sulphur Trioxide (SO <sub>3</sub> ),max %	3.0
Moisture Content, max %	3.0
Loss on ignition, max %	6.0
Avail. Alkaline as Na <sub>2</sub> O,max %	1.5
Percent Retained on 45-micrometer (No. 325) Sieve, max %	5.0
Specific Surface(Nitrogen adsorption)	
min m /g	18
max m /g	28

Silica fume shall not be used in dry form.

#### (C) Removal of Concrete and Surface Preparation.

(1) Removal of concrete shall consist of the following steps:

(a) Scarification to remove 1/4" to 1/2" thickness for the entire area of the deck.

- (b) Removing deteriorated concrete up to top layer of the existing reinforcement, at designated locations as shown on the plans or as directed by the Chief Engineer.
    - (c) Removing concrete to depths below the top layer of reinforcement if additional loose or deteriorated concrete is detected. Such additional removal shall be done only upon approval by the Chief Engineer.
  - (2) All bridge deck areas to be overlaid shall be protected from intrusion from construction operations and by adhering to the following conditions:
    - (a) Barricades shall be placed between all work areas and adjacent public areas.
    - (b) Plywood shall be placed over any surface that concrete or oil-leaking equipment will pass over.
    - (c) Water run-off shall be controlled to prevent staining of non-construction areas or automobiles.
  - (3) Surface preparation:
    - (a) The existing concrete surface upon which concrete is to be placed shall be pre-saturated with water and kept continuously wet at least 12 hrs before placing concrete.
    - (b) Immediately, prior to concrete overlay placement, the existing, roughened concrete surface shall be SSD (Saturated, Surface-Dry), clean, free of all dust, dirt, grease, oil, wax, debris or other foreign matter. The concrete surface pore structure shall be open.
    - (c) The existing concrete surface temperature shall not be less than 40°F or greater than 85°F at the time of concrete placement.
- (D) **Equipment** – As per 714.02(C), except that all scarification removal of concrete shall be done by hydro-jetting.
- (E) **Construction Methods.**
  - (1) The Contractor shall have a technical representative of the Silica Fume manufacturer available at the job site at all times during placement of overlay at no additional cost to the District. After the surface has been cleaned and immediately before placing concrete, a thick coating of bonding grout shall be scrubbed into the wet, prepared surface. This bonding grout shall consist of two parts of fine sand and one part portland cement plus micro silica (in the same proportion as the mix design) mixed with water to give a thick paint or creamy consistency. Care shall be exercised to insure that all parts receive a thorough, even coating and that no excess grout is permitted to collect in pockets. The rate of progress in applying grout shall be limited so that grout does not become dry before it is covered with new concrete.
  - (2) Discharge of concrete from the delivery trucks shall be completed within 60 minutes after introduction of mixing water to the cement and aggregates.

- (3) The new concrete shall be manipulated and mechanically struck off slightly above final grade. It shall then be mechanically consolidated and screeded to final grade with slope to the drains.
- (4) Fresh concrete, 3 inches or more in thickness, shall be vibrated internally in addition to the surface screed vibration.
- (5) Immediately after leveling to final grade, start finishing with bull float to produce a tight, uniform surface. Use a light fog-spray of water to keep the concrete surface moist between the finishing operations.
- (6) After the broom finish, continue light fogging only as necessary to keep the concrete surface wet before start of curing.
- (7) When a tight uniform surface has been achieved, the surface shall be textured in accordance with 703.21(C).

**(F) Curing.**

- (1) At the time when fresh concrete can support a worker's weight without damaging the finish, cover the surface with a single layer of wet burlap. Cover burlap with layer of clear 4 mil thick polyethylene sheeting.
- (2) Provide a wet burlap cure for at least 7 days. The burlap shall meet the requirements specified in 814.01. The burlap shall be kept continuously wet. Do not cover the wet burlap.
- (3) For 14 days after casting, the concrete shall be protected from damage due to mechanical disturbances such as shock and vibration due to adjacent construction activity. Protect finished concrete surfaces for damage.

**(G) Tolerances** – Horizontal surfaces shall be true planes within 1/4 inch in 10 feet as determined by a 10 foot straightedge placed anywhere on the surface in any direction (Class B per ACI 301-84).

**(H) Contractor Quality Control** – As a minimum, the Contractor shall conduct a program of field quality control as outlined in the following paragraphs:

- (1) For each placement before concrete is placed, the following shall be inspected and approved:
  - (a) Existing slab surface cleanliness, temperature and water saturation.
  - (b) Concrete batch ticket.
  - (c) Elapsed time since batching and number of mixing truck drum revolutions.
  - (d) Concrete temperature.
  - (e) Hot weather concreting conditions.
  - (f) Slump in accordance with ASTM C 143-78 for each truck load.
  - (g) Air content per ASTM C231-82 for each truck load.
  - (h) Water addition at the site.

- (2) The slump shall be measured at the job site before addition of the high-range water reducer, if it is added at the job site. The slump shall also be measured at the point of final placement.
- (3) The air content shall be measured at the point of final placement.
- (4) Concrete test specimens shall be made in accordance with ASTM C31-88. One set of samples shall be taken not less than once day nor less than once for each 4,000 square feet of surface area cast in one day. Each set shall consist of six (6) cylinders. The specimens shall be tested for compressive strength in accordance with ASTM C39-85. Two (2) specimens shall be tested at seven (7) days and three (3) specimens at twenty-eight (28) days. The sixth specimen shall be held in reserve. The samples for strength test shall be removed from concrete at the point of final placement.

**(I) Limitations of Operations.**

- (1) A bulkhead shall be installed in case of major delay in the placement operation. During minor delays of one hour or less, the end of the placement may be protected from drying with several layers of wet burlap.
- (2) The elapsed time between depositing the concrete on the floor and final screeding shall not exceed ten (10) minutes.

At transverse and longitudinal joints, the surface course previously placed shall be sawn to a straight and vertical edge before the adjacent surface course is placed. No edges shall be chipped. Concrete shall not be placed adjacent to a surface course less than 36 hours old except to a continuation of placement in a lane or strip beyond a joint in the same lane or strip. As soon as finishing has been completed, all vertical joints with adjacent concrete shall be sealed by painting with thinned grout.

- (3) Screed rails or trips may be removed at any time after the concrete overlay has taken initial set. Adequate precaution shall be taken during screed removal to protect the edge of the new surface from damage.
- (4) Preparation of any area may be started in a lane or strip adjacent to newly placed overlay 24 hours following its placement. During the next 7 days following the placement of the overlay, the work shall be restricted as follows:
  - (a) No operations shall be undertaken which will interfere with the curing process.
  - (b) No power-driven tools, including chipping and jack hammers shall be used.
  - (c) No vehicles or construction equipment shall be permitted on a finished overlay until water curing is complete. At temperatures below 50°F, a longer waiting time will be required.

- (J) **Cleanup** – Debris shall not be allowed to accumulate at any time. Clean-up and debris removal shall be done daily.
- (K) **Protection** – The Contractor shall be responsible for protecting the work from damage such as impact, overloading, marring of surfaces or other damage until Final Acceptance.
- (L) **Acceptance** – Should an approval not be obtained for any work requiring approval, such work and all subsequent work will be rejected. Appearance of plastic shrinkage cracks

due to inadequate finishing and curing shall be cause for rejecting the work so affected. Surface concrete in the rejected area shall be removed and replaced at no additional cost to the Department.

#### **714.05 MEASURE AND PAYMENT**

- (A) **Measure** – The unit of measure for the various types of Bridge Deck Concrete Overlay will be the square yard, complete in place. The number of square yards will be the actual surface area computed from measurements taken in the field.
- (B) **Payment** – Payment for the specified type of Bridge Deck Concrete Overlay will be made at the contract unit price per square yard, which payment will include removal and disposal of existing asphalt surface and membrane waterproofing, scarifying if specified, sandblasting, air cleaning, grouting, and proportioning, mixing, placing, finishing, and curing concrete. Payment will also include the cost of furnishing all materials, tools, equipment, incidentals and labor necessary to complete the item as shown on the plans and specified herein.
- (C) **Payment for Deck Repair** – Payment for removal and disposal of deteriorated concrete beyond the prescribed thickness will be paid for at the contract unit price per cubic yard for Structure Hard Surface Excavation.

## 715 CONCRETE BRIDGE DECK REPAIR

### 715.01 DESCRIPTION

This work shall consist of removing a specified amount of the existing bridge deck mechanically or through hydro-jetting, removal of additional areas of deteriorated concrete, cleaning all surface areas to be repaired, replacing deteriorated reinforcing steel, and placing repair concrete.

### 715.02 MATERIALS

- (A) **Portland Cement Concrete** – Concrete shall conform to Class A or Class B unless otherwise specified or shown on drawings, but shall contain aggregates no greater than 1/2 inch nominal size.
- (B) **Epoxy Resin Adhesive (bonding agent)** – Epoxy adhesive shall conform to AASHTO M235 Type III, two part mix equal parts (1:1), thixotropic, and in accordance with 822.08(B) (1).
- (C) **Alternate Concrete Bonding Agent** – Bonding agent compound for bonding uncured concrete to existing concrete shall be Thorobond, Weld-Crete, Link, or approved equal with a polyvinyl acetate homopolymer base for surface bonding application.

### 715.03 EQUIPMENT

#### (A) Removal Equipment

- (1) Existing Wearing Surface – This equipment shall only be required when the existing bridge contains an asphalt wearing surface. It shall be capable of removing the wearing surface without damaging armored joints that are to remain or the existing concrete surfaces beyond the specified minimum removal depth. When pavement breakers are proposed, broad face chisel blades shall be used and operated at a slight angle with the horizontal to peel off the wearing surface.
- (2) Concrete Surface – Power operated mechanical type or high pressure water jet type equipment shall be capable of uniformly removing the specified minimum depth from the existing concrete surface.
  - (a) Mechanical Type – This equipment shall be limited to depths not closer than ½ inch from the top of the existing reinforcement. When additional removal is required, it shall be performed by high pressure water jet, power driven hand tools or hand tools.
  - (b) High Pressure Water Jet (Hydro-jetting) – This equipment may be used to any depth above and below the reinforcing steel. The runoff water shall be satisfactorily controlled to prevent it from reaching any traveled roadway, waterways, or any other areas designated in the Plans or by the Chief Engineer.
  - (c) Power Driven Hand Tools – This equipment shall be used for removal of unsound concrete or to achieve the required depth when deeper than ½ inch above the top of existing reinforcing steel. Pneumatic hammers heavier than a nominal 60 pound class shall not be used, and chipping hammers heavier than a

nominal 15 pound class shall not be used to concrete from beneath any reinforcing steel.

- (d) **Hand Tools** – Hand tools such as hammers and chisels shall be provided for removal of remaining particles of unsound concrete from beneath existing reinforcing steel or to achieve the required depth of removal.
- (e) **Cleaning** – This equipment shall be capable of removing rust scale and old concrete from reinforcing steel and small chips of concrete partially loosened by the removal. Abrasive blasting shall not be used when epoxy coated reinforcing steel is present in the concrete.

**(B) Placement Equipment** – Equipment shall conform to 905.

#### 715.04 REMOVAL

- (A) **Asphalt Wearing Surface Removal** – The asphalt wearing surface, if present, shall be removed to the limits shown in the Plans.
- (B) **Inspection** – The Chief Engineer shall inspect the entire exposed portion of the deck and designate the extent and depth of concrete removal.
- (C) **Concrete Removal** – The previously designated areas to be repaired shall be outlined with saw cuts to a depth of at least 1 inch. The areas of deteriorated concrete shall be removed down to sound concrete by means of the appropriate equipment. At a minimum concrete must be removed  $\frac{3}{4}$  inch below the top mat of reinforcing steel in the deck. The proposed removal method is subject to the approval of the Chief Engineer. Where it is anticipated that the depth of removal will be half of the original concrete deck thickness and deeper removal is possible, the Contractor shall furnish and erect temporary protective shields in accordance with 626.
- (D) **Reinforcing Steel** – Exposed reinforcing steel shall be cleaned. Epoxy coated reinforcing steel shall not be cleaned by abrasive blasting. Damaged epoxy coating shall be repaired in accordance with 704.09(D). Reinforcing steel that is damaged or deemed unsuitable by the Chief Engineer shall be lapped 30 bar diameters on each side of the damaged portion with new bars of the same size if sufficient length of the existing bar is exposed. Otherwise the new bar shall be welded or mechanically connected in accordance with 704.

#### 715.05 CONCRETE DECK REPAIR

##### (A) Surface Preparation

- (1) **Cleaning** – After the completion of removal of deteriorated concrete, remove all dirt, oil or other foreign material followed by an airblast cleaning using compressed air with a high velocity nozzle.
- (2) **Bonding Agent** – An epoxy resin adhesive shall be applied to the prepared surface. Adhesive shall be applied when the ambient air temperature is in excess of 60°F unless otherwise recommended by the manufacturer. The adhesive shall be in “Tacky” condition immediately prior to placing repair material.

- (B) **Repair Types** – The top surface of all deck repairs shall be flush with the top of the adjacent concrete deck, and the concrete will be cured in accordance with 703.
- (1) **Partial Depth Deck Repair** – This repair shall include all areas where the depth of deck removal is less than the full depth of the original concrete deck. The Contractor shall fill the void with Class A Concrete.
  - (2) **Full Depth Deck Repair** – This repair shall include all areas where the depth of deck removal is the full depth of the original concrete deck. The Contractor shall fill the void with the concrete class specified on the Plans. For areas greater than 4 square feet, forms shall be supported by blocking erected from the existing girders. Otherwise forms may be suspended from existing reinforcing steel by wire ties. All forms shall be removed upon completion of the concrete curing process.

#### **715.06 MEASURE AND PAYMENT**

- (A) **Measure** – The unit of measure for the various types of Concrete Bridge Deck Repair will be the square foot, complete in place. The number of square feet will be the actual surface area computed from measurements taken in the field.
- (B) **Payment** – Payment for the specified type of Concrete Bridge Deck Repair will be made at the contract unit price per square foot, which payment will include removal and disposal of existing asphalt surface and membrane waterproofing, abrasive blasting, air cleaning, grouting, and proportioning, mixing, placing, finishing, and curing concrete. Payment will also include the cost of furnishing all materials, tools, equipment, incidentals and labor necessary to complete the item as shown on the plans and specified herein.

## 716 REPAIR-REPLACE PCC STRUCTURE

**716.01 GENERAL** – the materials and methods specified below apply to the particular types of structural repairs as shown on the plans and specified herein.

Due to the time interval between the field survey and notice to proceed, further deterioration may have occurred which would not be reflected in the quantities for the particular bid item; the chief engineer will be the sole judge of the extent and total quantity of repairs that are to be made.

### 716.02 MATERIALS:

- (A) **Portland Cement Concrete** – Concrete shall conform to Class B High Early Strength Concrete otherwise specified or shown on drawings, but shall contain aggregates no greater than 1/2 inch nominal size.
- (B) **Non-shrink Grout** – A propriety formulation with a minimum bond strength of 2000 psi per ASTM C882, compressive strength of 5000 psi minimum after 24 hours per ASTM C579.
- (C) **Non-shrink Mortar** – Mortar shall be cement base non-shrink type meeting the requirements of ASTM C109 for 3000 psi, 28 day strength. It shall be non-sag, stiff consistency for vertical surfaces, and capable of adhering to damp concrete surfaces.
- (D) **Epoxy Resin Adhesive (bonding agent)** – Epoxy adhesive shall conform to AASHTO M235 Type III, two part mix equal parts (1:1), thixotropic.
- (E) **Low Viscosity Epoxy Grout for Pressure Injection Grouting** – High-modulus, moisture insensitive, low-viscosity, for application at not less than 40 ° F, fast setting, rigid, for grouting both damp and dry cracks. ASTM C881 Types IV, Grade 1, Class B and C. If recommended by epoxy manufacturer, provide a compatible surface sealer. Pressure injection shall be carried out in strict accordance with manufacturer's instruction.
- (F) **Surface Sealant** – Epoxy resin used to seal cracks and ports before injection. ASTM C881, Type IV, Grade 3, Class B and C.
- (G) **Caulking Compound** – A one component, non-sag (gun grade) urethane sealant, color gray, meeting Federal Specification TT-S-00230C Type II for vertical use and ASTM C920.
- (H) **Welded Wire Fabric Reinforcement** – AASHTO M55 non-deformed wire fabric.
- (I) **Non-Shrink Epoxy Grout** – A proprietary formulation, rapid set, flowable epoxy grout, for tight clearances meeting applicable AASHTO Specifications for epoxy and cement components, non-shrink per ASTM C827 and tensile strength of 2000 psi minimum per ASTM C190.
- (J) **Epoxy Mortar** – Epoxy-cement, proprietary formulation, non-metallic, non-flowable, stiff consistency and in accordance with 806.05(C).

- (K) **Mastic Lubricant** – Non-flowable material, wash resistant to moisture, compatible with elastomeric material, molybdenum disulfide base.
- (L) **Alternate Concrete Bonding Agent** – Bonding agent compound for bonding uncured concrete to existing concrete shall be Thorobond, Weld-Crete, Link, or approved equal with a polyvinyl acetate homopolymer base for surface bonding application.
- (M) **Anchor Bolts** – Self-anchoring bolts shall be per 822.06(B)

#### 716.03 SUBMITTAL:

- (A) **Materials Certification** – Submit certification for all materials in accordance with 822.08(D).
- (B) **Construction Drawings** – Submit construction drawings and calculations showing temporary shoring and support systems (if applicable).
- (C) **Drawing Certification** – Shop drawings and construction drawings shall be certified by a Professional Engineer registered in the District.
- (D) **As-Built Drawings** – As-Built drawings shall indicate the type, location and extent of the repairs and the products and methods actually used.

#### 716.04 CONSTRUCTION METHOD CONCRETE REPAIR OR PATCH

- (A) **Limits of Deterioration** – The extent for removal of deficient concrete shall be as indicated by sounding with a hand held steel hammer. A hollow sound indicates deficiency. All sounding shall be performed in the presence of the Chief Engineer or his designated representative. Where sounding indicates a deficient area has increased beyond that indicated on the contract drawings, obtain the Chief Engineer's approval before commencing work.
- (B) **Concrete Removal** – The limits of the repair areas previously designated shall be saw cut along neat lines to a depth of at least 1 inch so as to obtain a rectangular area. The saw cut lines shall encompass the area of deterioration by maintaining a minimum of 2 inches offset from the designated area of deterioration. Special care shall be taken to protect any parts of the structure that are not specifically to be removed. Pneumatic hammers may be used to remove unsound concrete. The maximum hammer size is 90 pound class. All devices proposed for concrete removal shall be approved by the Chief Engineer.
- (C) **Depth of Concrete Removal** – Concrete shall be removed in the previously designated areas to depth at which sound concrete is found. The depth at which sound concrete is found will determine the type of repair to be utilized as follows:
  - (1) Depth Greater Than 4 Inches – Repair Type 1, Concrete Repair
  - (2) Depth 4 Inches or Less – Repair Type 2, Concrete Patch

After concrete removal to a depth of 2 inches has taken place, the Chief Engineer shall have the option to remove additional concrete depth and designate which repair type will be used. Payment shall be made under the repair type designated.

- (D) **Existing Reinforcing Steel** – Extreme care shall be taken when removing concrete so as not to damage the existing reinforcing steel. If the reinforcing steel is damaged or deemed unsuitable by the Chief Engineer, it shall be replaced by dowel bars that are the same diameter as the damaged reinforcing steel. The minimum size of a replacement dowel shall be a #5 bar. The replacement dowel bars shall be provided at the Contractor's expense.
- (E) **Under Cut** – The perimeter of the repair area shall be under cut or bevel cut to key in the proposed repair.
- (F) **Surface Preparation** – The repair areas shall be structurally sound and free from all dust, dirt, grease, paint and other foreign material. Exposed reinforcing steel shall be sandblasted to a bright metal. The concrete surfaces that are to be repaired shall then be blown clean with oil-free and clean air.

#### 716.05 REPAIR TYPE 1, CONCRETE REPAIR.

- (A) **Welded Wire Fabric with Anchors** – Place 3/8 inch diameter concrete anchors at a maximum spacing of 18 inch on centers in each direction and attach welded wire fabric to anchors. A minimum of one anchor is required per repair area. The welded wire fabric shall be of an appropriate size to fill the repair area.
- (B) **Forms** – Set forms maintaining all chamfers and flush with adjacent concrete surface. Provide adequate ports in forms for applying the bonding agent and placing repair concrete. The forms shall be removable. Provide a minimum of 1 inch cover by bending existing reinforcement back behind finished surface if required.
- (C) **Bonding Agent** – An epoxy resin adhesive shall be applied to the prepared surface. Adhesive shall be applied when the ambient air temperature is in excess of 60°F unless otherwise recommended by the manufacturer. The adhesive shall be in tacky condition immediately prior to placing repair concrete.
- (D) **Repair** – Fill cavity with repair concrete, finish and cure concrete in accordance with 703.

#### 716.06 REPAIR TYPE 2, CONCRETE PATCH.

- (A) **Forms** – Set forms maintaining all chamfers and flush with adjacent concrete surface. Provide adequate ports in forms for applying the bonding agent and placing repair concrete. The forms shall be removable. Provide a minimum of 1 inch cover by bending existing reinforcement back behind finished surface if required.
- (B) **Bonding Agent** – An epoxy resin adhesive shall be applied to the prepared surface. Adhesive shall be applied when the ambient air temperature is in excess of 60°F unless otherwise recommended by the manufacturer. The adhesive shall be in a tacky condition immediately prior to placing repair material.
- (C) **Repair** – The material used to effect this repair type shall conform to either of the following:
  - (1) **Epoxy Mortar** – Finish and cure in accordance with the manufacturer's specifications and 703.

- (2) Non-Shrink Grout – Finish and cure in accordance with the manufacturer's specifications and 703.

#### **716.07 REPAIR TYPE 3, CRACK REPAIR.**

- (A) **General** – The work covered by this item includes surface repair of concrete cracks by pressure injection of epoxy as shown on the contract documents. The method of application shall be approved by the Chief Engineer prior to beginning work.
- (B) **Locations** – Prior to the beginning of work, the Chief Engineer will mark the exact crack locations to receive epoxy injection.
- (C) **Damage** – Extreme caution shall be taken when selecting a pressure necessary to complete crack repair so as not to damage the structure by causing additional cracking. If additional damage occurs, the Contractor shall bear full responsibility.
- (D) **Surface Preparation.**
  - (1) **Cleaning** – Concrete surfaces shall be clean and sound. Clean all cracks of loose matter such as dirt, laitance, oil, grease, salt or any other contaminants by sandblasting compressed air.
  - (2) **Surface Seal** – If necessary, apply surface seal material to the crack and establish entry ports in the surface seal at 6 to 18 inches apart. Substrate temperatures shall not be less than 40°F or as recommended by the epoxy manufacturer. Allow surface seal to set before beginning injection procedure.
- (E) **Injection** – Inject low viscosity epoxy adhesive at the lowest port. Continue injection until epoxy begins to flow out of the port at the next higher level. Plug the first port and start injection at the second port. Repeat until all of the ports are filled. Allow epoxy to cure as per the manufacturer's specifications.
- (F) **Finish** – After the epoxy injection is complete, all entry ports shall be removed and all excess surface seal and epoxy shall be removed flush with adjacent concrete surfaces.
- (G) **Testing.**
  - (1) **First Test** – After the completion of the first crack repair, the Chief Engineer shall designate a random location within the finished crack repair to be cored. Extreme care shall be taken in the selection of the core locations to avoid primary reinforcing steel. The core shall be 1 inch in diameter, and shall extend to the depth of crack being investigated. This core will be examined by the Chief Engineer to verify the full sealing of the crack. If the crack is not sealed to the satisfaction of the Chief Engineer, the procedure used for crack injection will be modified.
  - (2) **Additional Tests** – The Chief Engineer shall designate one location for every 25 linear feet of crack repair and no less than one additional random location where the cracks have been epoxy injected for the Contractor to core. These cores will be examined by the Chief Engineer to verify full sealing of the cracks.
  - (3) **Core Holes** – The core holes shall be filled with a non-shrink grout and finished to the satisfaction of the Chief Engineer.

**716.08 MEASURE AND PAYMENT****(A) Repair Type 1 – Concrete Repair.**

- (1) Unit of Measure – The unit of measure will be the square foot.
- (2) Payment – Payment will be made at the contract unit price per square foot, for which payment will include furnishing all materials, labor, tools and equipment to accomplish the work specified.

**(B) Repair Type 2 – Concrete Patch.**

- (1) Unit of Measure – The unit of measure will be the square foot.
- (2) Payment – Payment will be made at the contract unit price per square foot, for which payment will include furnishing all materials, labor, tools and equipment to accomplish the work specified.

**(C) Repair Type 3 – Crack Repair.**

- (1) Unit of Measure – The unit of measure will be the linear foot of crack repaired.
- (2) Payment – Payment will be made at the contract unit price per linear foot, for which payment will include furnishing all materials, labor, tools and equipment to accomplish the work specified and shown.

## 717 ARMORED JOINT WITH NEOPRENE STRIP SEAL

### 717.01 DESCRIPTION

Work consists of furnishing and erecting at various locations an armored joint with neoprene strip seal, including neoprene extrusions, steel angles, plates, extrusions, anchor studs, and fasteners as shown on the plans, as specified herein, and in accordance with the recommendations of the manufacturer.

### 717.02 MATERIALS

Materials shall meet the following requirements:

- |                          |                                   |
|--------------------------|-----------------------------------|
| (1) Steel Shapes, Plates | AASHTO M270, Grade 36 (ASTM A709) |
| (2) Steel Extrusions     | AASHTO M270, Grade 36 (ASTM A709) |
| (3) Deformed Bar Anchor  | AASHTO M225 (ASTM A496)           |
| (4) Anchor Studs         | ASTM A108                         |
| (5) High Strength Bolts  | 815.01(D)                         |
| (6) Adhesive See Below   |                                   |

Neoprene Strip Seal – The strip seal gland shall be preformed and manufactured from a vulcanized elastomeric compound using polychloroprene as the only base polymer, meet the requirements of ASTM D 2628 and have physical properties described as follows:

Adhesive – The adhesive lubricant used to install the strip seal gland into the steel extrusion shall be a one part moisture curing polyurethane compound meeting the requirements of ASTM D4070.

<b>PROPERTY</b>	<b>ASTM TEST</b>	<b>REQUIREMENTS</b>
Tensile strength	D 412	2,000 psi min.
Elongation at break	D 412	250 percent min.
Hardness, Type A durometer	D 2240 (modified)	60 +/- 5
Compression set, 70 hr. @ 212°F, maximum	D 395 Method B (as modified)	40 percent
Oven aging, 70 hr @ 212°F	D 573	
Tensile strength loss		20 percent max.
Elongation, loss		20 percent max.
Hardness, Type A durometer points change)		0 to + 10
Oil Swell, ASTM oil 3		
70 hrs @ 212° F weight change	D471	45% max
Ozone resistance	D 1149	No cracks

20 percent strain, 300 pphm, in air at 104°F (wiped with toluene to remove contamination)	(Modified)	
Low Temperature stiffening 7 days @ 14° F (-10° C) Hardness, type A Durometer Points change	D2240, Modified	0 to +15

### 717.03 SHOP DRAWINGS

The Contractor shall verify all dimensions to insure the accuracy of the joint prior to fabrication. Required shop drawings shall show the entire joint layout, with field splices of the extrusion and be submitted for approval prior to fabrication. Included shall be the type, location and details of the mechanical devices required to compress the joint to its required width based on the ambient temperature at the time of erection.

### 717.04 FABRICATION

The armored joint with neoprene strip seal shall be shop assembled and delivered to the job site ready for installation. The neoprene extrusion shall run continuously through the full width of the joint, including concrete barriers and sidewalks. No splices will be permitted in the neoprene seal. Splices of steel extrusions shall develop the full strength of the extrusion. Structural steel shall be fabricated per 706. All metal portions of the expansion joints not in direct contact with the neoprene strip seal shall be shop painted per 707.

### 717.05 CONSTRUCTION REQUIREMENTS

Immediately prior to installation, the neoprene strip seal shall be examined to insure that the seal is fully inserted in the recess. After the armored joint has been set to its proper line and grade and securely attached, all the temporary mechanical devices shall be removed and become the property of the Contractor. During stage construction, installed portions of the steel extrusion shall be protected from traffic and construction activity to the satisfaction of the Chief Engineer. Splices of the extrusions shall develop the full strength of the member.

After the armored joint has been erected and after all adjacent concrete has been placed, the joint shall be cleaned and painted in conformance with 707 for new metalwork.

### 717.06 MEASURE AND PAYMENT

The unit of measure for Armored Joint with Neoprene Strip Seal will be the linear foot along the center line of the joint, complete and in place.

Armored Joint with Neoprene Strip Seal will be paid at the contract unit price per linear foot, which payment will include painting and all labor, materials, tools, equipment and incidentals including steel angles, high-strength bolts, anchor studs, necessary to complete the work as specified herein.

## 718 NEOPRENE COMPRESSION SEAL

### 718.01 DESCRIPTION

Work consists of furnishing and installing neoprene compression seals to be used on joints where shown in the contract documents.

### 718.02 MATERIALS

The neoprene compression seal shape shall be the angled, webbed design as shown on plans and shall have the physical properties as per Section 807.06.

Adhesive – The lubricant-adhesive used when installing the preformed joint seals shall be as recommended by the seal manufacturer, and shall be a compound consisting of the same base polymer as the seals, blended with suitable volatile solvents. It shall have suitable consistency at the temperature at which the seals are to be installed, shall be compatible with the seals and the concrete, and shall be relatively unaffected by the normal moisture in the concrete.

The lubricant-adhesive shall be delivered in containers plainly marked with the manufacturer's name or trademark, lot number and date of manufacture.

### 718.03 CONSTRUCTION REQUIREMENTS

The temperature at the time of joint construction determines the width of the working joint. The Contractor shall form the joint allowing for temperature variations found on the drawing or as directed by the Chief Engineer.

The seal size for all joints shall be approved by the Chief Engineer and shall be suitable for the joint movement caused by thermal expansion and contraction.

Joint preparation shall be as shown on the contract drawings and shall otherwise conform to the manufacturer's recommendations. All surfaces to receive the compression seal shall be free from dirt, water, oil, rust, frost and any other loose foreign debris which may be detrimental to effective joint sealing. All joints to receive the compression seal shall be free from defects such as spalls, cracks or loose materials. The joint sides shall be constructed straight and parallel to each other to the proper width and depth as shown on the plans.

For ease of installation, the air temperature should be below 85°F. A continuous coat of adhesive shall be applied to both joint interfaces immediately prior to seal installation. The adhesive shall not be applied below 40°F. Unless otherwise specified, the seal shall be recessed 1/8 inch to 1/4 inch below the surface depending on seal size application and as directed by the Chief Engineer.

### 718.04 MEASURE AND PAYMENT

The unit of measure for Neoprene Compression Seal will be the linear foot, complete and in place.

Neoprene Compression Seal will be paid at the contract unit price per linear foot, which payment will include all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.



## **DIVISION 800 MATERIALS**

### **801 HYDRAULIC CEMENT/CEMENTIOUS MATERIALS**

- 801.01 Portland Cement
- 801.02 Masonry Cement
- 801.03 Blended Hydraulic Cement
- 801.04 Granulated Iron Blast Furnace Slag
- 801.05 Fly Ash Used in Portland Cement Concrete

### **802 BITUMINOUS MATERIALS**

- 802.01 General
- 802.02 Performance Graded Asphalt
- 802.03 Cut-Back Asphalt
- 802.04 Emulsified Asphalt
- 802.05 Bituminous Materials for Waterproofing
- 802.06 Softening Agent
- 802.07 Liquid Anti Strip Additive
- 802.08 Emulsified Asphalt for Concrete Vaults
- 810.09 Asphalt for Permeable Base

### **803 AGGREGATES**

- 803.01 Fine Aggregate for Portland Cement Concrete
- 803.02 Coarse Aggregate for Portland Cement Concrete
- 803.03 Fine Aggregate for Bituminous Concrete
- 803.04 Coarse Aggregate for Bituminous Concrete
- 803.05 Mineral Filler for Bituminous Concrete
- 803.06 Fine Aggregate for Masonry Mortar
- 803.07 Lightweight Aggregate for Structural Concrete
- 803.08 Aggregate for Slurry Seal
- 803.09 Aggregate for Bituminous Surface Treatment
- 803.10 Aggregate for Riprap

### **804 AGGREGATES FOR SOILS AND BASE COURSE CONSTRUCTION**

- 804.01 General
- 804.02 Embankment Backfill
- 804.03 Blanket Soil
- 804.04 Base Course and/or Structural Backfill
- 804.05 Trench Backfill
- 804.06 Trench Subgrade Gravel
- 804.07 Flowable Backfill

### **805 AGGREGATES FOR DRAINAGE**

- 805.01 General

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- 805.03 Coarse Aggregate for Underdrain
- 805.04 Blanket Soil for Underdrain
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  - 808.01 PCC Pipe
  - 808.02 Polyvinyl Chloride (PVC) Pipe
  - 808.03 Clay Pipe
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- 809 METAL PIPE AND FITTINGS
  - 809.01 Ductile Iron Pipe and Fittings
  - 809.02 Corrugated Metal Culvert Pipe and Pipe Underdrain
  - 809.03 Cast Iron Pipe
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- 810 VALVES AND HYDRANTS
  - 810.01 Valves
  - 810.02 Fire Hydrants
- 811 PAINTS, COATINGS AND PRESERVATIVES
  - 811.01 General
  - 811.02 Raw Materials
  - 811.03 Prime Coat
  - 811.04 Intermediate (Mid) Coat
  - 811.05 Topcoat
  - 811.06 Solvents
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  - 811.08 Wood Preservatives
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816 PILES

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- 824.02 Reflective Sheeting
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## 825 TRAFFIC SIGNAL MATERIAL

- 825.01 General
- 825.02 Light Emitting Diode (LED) Traffic Signal Modules
- 825.03 Light Emitting Diode (LED) Pedestrian Signal Module
- 825.04 Light Emitting Diode (LED) Countdown Pedestrian Signal Modules
- 825.05 Quality Assurance – Light Emitting Diode Signal Heads
- 825.06 Conventional Polycarbonate Pedestrian Signal Heads
- 825.07 Conventional Polycarbonate Vehicle Signal Heads
- 825.08 Vehicle Signal Backplate



**801 HYDRAULIC CEMENT/CEMENTIOUS MATERIALS****801.01 PORTLAND CEMENT**

- (A) **GENERAL.** Unless specified otherwise, portland cement shall be as specified in 801.01(B), except that for sewer and water work, portland cement shall be as specified in 801.01(C). The cement may be accepted on the basis of a manufacturer's certification furnished in accordance with the requirements of Section 106.13.

The temperature of the cement at time of delivery to the mixer shall not exceed 160°F.

Different brands of cement, the same brand of cement from different sources, or cements for which the chemical analysis indicates them to be of different types shall not be mixed for use on a project. Different brands of cement or the same brand of cement from different sources may be used alternately on a project only in case of an emergency and with the specific approval of the Chief Engineer.

For portland cement used in concrete with aggregates that are deleteriously reactive, the alkaline content of the portland cement shall not exceed 0.60 percent as described in optional requirements of AASHTO M 85.

- (B) **STANDARD PORTLAND CEMENT.** Standard portland cement shall meet the requirements of AASHTO M 85, Type I.
- (C) **MODERATE HEAT OF HYDRATION PORTLAND CEMENT.** Moderate heat of hydration portland cement for sewer and water work shall meet the requirements of AASHTO M 85, Type II.
- (D) **HIGH EARLY STRENGTH PORTLAND CEMENT.** High early strength portland cement shall meet the requirements of AASHTO M 85, Type III.
- (E) **WHITE PORTLAND CEMENT.** Portland cement for white portland cement concrete shall meet the requirements of AASHTO M 85, Type I, except that the cement shall contain not more than one half of one percent (0.50%) of Ferric Oxide ( $\text{Fe}_2\text{O}_3$ ) by weight.

**801.02 MASONRY CEMENT**

Masonry cement shall meet the requirements of ASTM C 91, Type M unless otherwise specified.

Masonry cement may be accepted on the basis of a manufacturer's certification furnished in accordance with the requirements of Masonry Cement Mill Certification available from the Engineer of Materials and Research. Different brands of cement or the same brand of cement from different sources may be used alternately on a project in the case of emergency and with the approval of the Chief Engineer.

**801.03 BLENDED HYDRAULIC CEMENT**

Blended hydraulic cement shall conform to AASHTO M 240 for Type IS or IP. A manufacturer's certification shall be furnished indicating the source, amount, and composition of the blended cement, and indicate that the material was tested during production or transfer

in accordance with this specification, and a report of the test results shall be furnished at the time of shipment.

#### **801.04 GRANULATED IRON BLAST FURNACE SLAG**

Granulated slag, when used as a substitute for Portland Cement, shall conform to the requirements of ASTM C 989, Grade 120. When blended with Portland Cement, the blend shall meet the requirements of 801.03, AASHTO M 240, Type 1S. Certification requirements of ASTM C 989 apply.

#### **801.05 FLY ASH USED IN PORTLAND CEMENT CONCRETE**

Fly ash used in Portland Cement Concrete shall meet the requirements of AASHTO M 295, Class C or Class F, except that the maximum loss in ignition for Class C and Class F shall be 4.0 per cent. The supplemental requirements of Table 2A shall apply when required by the Chief Engineer. When blended with Portland Cement, the blend shall meet the requirements of 801.03, and AASHTO M 240, Type 1P.

Written certification is required that all pozzolan meets these specifications for physical and chemical requirements.

**802 BITUMINOUS MATERIALS**

**802.01 GENERAL**

In accordance with the quality control plan of the manufacturer and as approved by DDOT QA/QC Division, each delivery of bituminous material shall be accompanied by a copy of recently (not more than 4 weeks) certified results of test on the material being delivered and a statement as to the type and amount of material contained in each carrier and the identification of the storage tanks from which the material is being delivered. This statement shall be presented to the Chief Engineer or his representative upon delivery.

**802.02 PERFORMANCE GRADED ASPHALT**

**(A) PERFORMANCE GRADED ASPHALT BINDER** – Mixes containing all virgin materials shall conform to AASHTO M-320, Table 1. The asphalt binder recovered from the final plant mixed material will be considered Rolling Thin Film Oven (RTFO) material and shall conform to AASHTO M-320 for the specified performance grade.

The PG binder shall be pre-approved by DDOT.

The Contractor shall submit a certificate of analysis showing conformance with the PG Binder Specification AASHTO M-320

The PG binder for HMA mixes shall be achieved by the use of neat asphalt with elastomer polymer modifications when needed.

Functional Classification of Streets	Asphalt Binder
Interstate	P.G. 70-22
Other Freeways and Expressways	P.G. 70-22
Principal Arterials	P.G. 70-22
Minor Arterials	P.G. 64-22
Collectors	P.G. 64-22
Local Streets	P.G. 64-22

**(B) CERTIFICATION** – The manufacturer and hauler shall furnish as specified.

The manufacturer shall also certify:

- (1) Date and time of loading
- (2) Tank or blending system
- (3) Identification of hauling unit
- (4) Binder grade, temperature and quantity of materials
- (5) Complete certified analysis
- (6) Lot number, if applicable
- (7) Mixing and compaction temperatures when the binder is polymer modified.

The hauler shall also certify:

- (1) Identification of hauling unit
- (2) Binder grade and source of last delivery
- (3) The date of last delivery using this hauling tank and volume of material remaining in the tank at the time of current loading.

**(C) PERFORMANCE GRADED ASPHALT MATERIAL FOR PARTIAL RE-CYCLING** – As specified by the Chief Engineer.

**802.03 CUT-BACK ASPHALT**

Unless otherwise specified, cut-back asphalt shall meet the requirements of AASHTO M 82 for the Type and Grade specified.

Cut-back asphalt to be used as prime coat shall meet the requirements of AASHTO M 82, Grade MC-30.

**802.04 EMULSIFIED ASPHALT**

Emulsified asphalt for securing mulch shall meet the requirements of AASHTO M 140, SS-1 or AASHTO M 208 for the Type and Grade specified.

Emulsified asphalt to be used as tack coat shall meet the requirements of AASHTO M 140, Grades SS-1, SS-1h, or as specified.

**802.05 BITUMINOUS MATERIALS FOR WATERPROOFING**

- (A) **ASPHALT PRIMER FOR WATERPROOFING.** Asphalt primer for waterproofing shall meet the requirements of ASTM D-41.
- (B) **ASPHALT SEAL FOR WATERPROOFING.** Asphalt seal for waterproofing shall meet the requirements of ASTM D-449.
- (C) **TAR PRIMER FOR WATERPROOFING.** Tar primer for waterproofing shall meet the requirements of D-450. For 2-ply waterproofing, Tar Primer shall be a liquid water gas tar or coal tar conforming to the following requirements:

Specific Gravity, 25/25° C (77/77° F)	1.03 to 1.12
Engier Viscosity, 40° C (104° F)	3 max.
Total Distillate, to 300° C (572° F)	50 max. by wt.
Bitumen Soluble in Carbon Disulphide	95% min.
Water	3.0 max. by total wt.

- (D) **COAL-TAR PITCH SEAL FOR WATERPROOFING.** Coal-tar pitch seal for waterproofing shall meet the requirements of for the type specified.
- (E) **BITUMINOUS SATURATED COTTON FABRIC.** Bituminous saturated cotton fabric used in waterproofing shall meet the requirements of.
- (F) **WATERPROOFING MEMBRANE.** Waterproofing membrane shall conform to ASTM D 6153.

**802.06 SOFTENING AGENT**

Softening agents used to reconstitute the bitumen of recycled asphaltic concrete shall be asphalt cement or a modifying agent and shall conform to these specification requirements.

**802.07 LIQUID ANTI STRIP ADDITIVE**

The Chief Engineer shall determine the compatibility of the asphalt, aggregates, and liquid anti strip additive proposed for use in accordance with 818.02. Liquid anti strip additives shall be introduced at the refinery or at the plant by line blending, metering or other measuring to assure accurate proportioning and thorough mixing.

**802.08 EMULSIFIED ASPHALT FOR CONCRETE VAULTS**

Emulsified asphalt used as a protective coating and moisture barrier for cast-in-place and precast concrete vaults, shall meet the requirements of ASTM D1227, Type I.

**802.09 ASPHALT FOR PERMEABLE BASE**

Asphalt for Permeable Base shall conform to the following:

Property	AASHTO Test	Spec.	Deviation
Test on Original Binder	100	90 or remove	
Rotational Viscosity @ 135°C, Pa-s	TP 48	3.0	---
Dynamic Shear, 10 rad/s, G*/Sin Delta, kPa	TP 5	1.00+ @ 76°C	0.99-
Flash Point, °C	T 48	232+	
Solubility, percent	T 44	99.0+	---
Sep. of Polymer, 163°C, 48 hr. °C, dif R&B top to bot	2-	---	
Force Ductility Ratio (f2/f1, 4°C, 5cm/min., f2 @ 30 cm elongation	T 300	0.30+	0.29-
Force Ductility, 4°C, 5 cm/min, 30 cm elongation, kg	T 300	---	---
Test on Rolling Thin Film Residue	T 240	---	---
Mass Loss, percent	T 240	1.00-	1.01+
Dynamic Shear, 10 rad/s, G*/Sin Delta, kPa	TP 5	2.20+ @ 76°C	2.19-
Elastic Recovery. 25°C, 10 cm elongation, percent	T 301	60+	59-
Ductility, 25°C, 5 cm/min, cm	T 51	---	---
Test on Pressure aging Vessel	PP 1		

## Residue

Dynamic Shear, @ 25°C 10 rad/s, G*/Sin Delta, kPa	TP 5	5000-	---
Bending Beam Creep Stiffness, S, Mpa @ -12°C	TP 1	300-	---
Bending Beam Creep Slope, m value @ -12°C	TP 1	0.300+	---

Rotational Viscosity will be measured to determine product uniformity. The rotational viscosity measured by the supplier shall be noted on the Certificate of Delivery. A binder having a rotational viscosity of 3.0 Pa-s or less will typically have adequate mixing and pumping capabilities. Binders with rotational viscosity values higher than 3.0 Pa-s should be used with caution and only after consulting with the supplier as to any special handling procedures and guarantees of mixing and pumping capabilities.

Solubility - Not all polymers are soluble in the specified solvents. If the polymer modified asphalt digested in the solvent will not pass the filter media, a sample of the base asphalt used in making the polymer modified asphalt should be tested for solubility. If the solubility of the base asphalt is at least 99.0%, the material will be considered as passing.

Separation of Polymer Test - to be used for pre-blended modified asphalt cement materials.

Elastic Recovery - AASHTO T 301 except the standard v-shaped sides for the specimen mold shall be replaced by straight-sided inserts of the same length, so that the specimen will contain a section 1 cm x 1 cm x 3 cm.

## 803 AGGREGATES

### 803.01 FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE

Fine aggregates for portland cement concrete (other than lightweight aggregate) shall meet the size and quality requirements of AASHTO M 6 as modified herein. The weighted loss shall not exceed 12 percent by weight when the fine aggregate is subjected to 5 cycles of the magnesium sulfate soundness test, as per AASHTO T 104.

To determine the degree of uniformity of the fine aggregate, fineness modulus (FM) determinations shall be made on representative samples from each source. Thereafter, if the fineness modulus varies by more than 0.20 from the value established on representative samples, the fine aggregate shall be rejected until suitable adjustments are made in the concrete proportions to compensate for the difference in grading.

Alkaline reactivity of fine aggregate shall be tested in accordance with AASHTO M-6, ASTM C 227 and ASTM C 289. Fine aggregate capable of producing a deleterious reaction when combined with Portland cement shall not be used in Portland cement concrete.

The amount of deleterious substances shall meet the requirements of AASHTO M 6, Class A.

Chert, metaquartzite or a combination of both shall not exceed eight percent by weight per ASTM C295.

Alkali-silica reactive constituents shall not exceed 0.05 percent expansion at six months per ASTM C227, and will be acceptable only when classified as innocuous per Figure 2, ASTM C289

For alkali-carbonate reactive constituents, test specimen cylinders shall not exceed 0.08 percent expansion after 28 days immersion in a 1 N NaOH solution per ASTM C586.

Organic impurities shall produce a color not darker than Organic Plate No. 2 per AASHTO T21 or ASTM C40.

Fine aggregate for portland cement concrete shall be well graded from coarse to fine shall conform to the requirements of AASHTO M6.

### 803.02 COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE

Coarse aggregate for portland cement concrete, (other than light-weight aggregates) shall consist of gravel, crushed gravel, crushed stone, crushed air-cooled blast furnace slag, crushed trap rock, or other approved inert materials of similar characteristics, or a combination thereof as specified, and shall meet the quality requirements of AASHTO M 80, and shall meet the size requirements of AASHTO T 96. Material shall have a bulk dry specific gravity greater than 2.88 in order to be classified as trap rock as defined in ASTM C 294, Section 15.4.

The percentage of wear as determined by the Los Angeles Abrasion Test shall not exceed 40, as per AASHTO T 96. The weighted percentage of loss shall not exceed 15 percent by weight when the coarse aggregate is subjected to 5 cycles of the magnesium sulfate soundness test per AASHTO T 104.

The amount of deleterious substance shall meet the requirements of AASHTO M 6, Class A.

Chert, metaquartzite or a combination of both shall not exceed three percent by weight per ASTM C295 petrographic.

Alkali-silica reactive constituents shall not exceed 0.05 per cent expansion at six months per ASTM C277, and will be acceptable only when classified as innocuous per Figure 2, ASTM C289 and meet the criteria of AASHTO M 6.

For alkali-carbonate reactive constituents, test specimen cylinders shall not exceed 0.08 percent expansion after 28 days immersion in a 1 N NaOH solution per ASTM C586.

Organic impurities shall produce a color not darker than Organic Plate No. 1 per AASHTO T21 or ASTM C40.

After first dry sieving on the No. 200 sieve in accordance with AASHTO T 27, the adherent coating on coarse aggregate as tested in accordance with AASHTO T 11, with a wetting agent added to the wash water, shall not exceed 1 percent by weight.

### 803.03 FINE AGGREGATE FOR BITUMINOUS CONCRETE

(A) **FOR HOT ASPHALTIC CONCRETE PAVEMENT.** Fine aggregate for hot asphaltic concrete pavement shall meet the general requirements of AASHTO M 29. The gradation of the fine aggregate or a combination of fine aggregates shall be such that, when combined with the other mix ingredients, it will produce the specified bituminous paving mixture. Each of the fine aggregates, when subjected to five cycles of the magnesium sulfate soundness test, shall have a weighted loss of not more than 20 percent.

Each individual ingredient or source of material combined to be fine aggregate, and the fine aggregate as a whole shall contain no clay lumps and shall be non plastic.

(B) **STONE-FILLED SHEET ASPHALT REPAIR.** Fine aggregates for stone-filled sheet asphalt surface shall meet the quality requirements of 803.03(A). The gradation of the fine aggregates or combination of fine aggregates shall be such that it will produce the specified bituminous mixture properties when combined with other mixed ingredients. The combined fine aggregates shall consist of not less than forty (40) percent by weight of crushed stones Grade No. 10 from an approved source containing from eight (8) to fifteen (15) percent fines passing the No. 200 sieve. The fine siliceous natural sand shall meet the gradation requirements for mortar sand per 803.06(A) except that the quantity passing the No. 200 sieve shall not exceed six (6) percent.

### 803.04 COARSE AGGREGATE FOR BITUMINOUS CONCRETE

Crushed stone or graded aggregate supplied from a quarry producing aggregates of asbestos bearing content or having asbestos present at the quarry are prohibited. Should such aggregates be utilized, both the Contractor and the stone supplier will be directed to remove all asbestos bearing aggregates and replace them with non asbestos bearing aggregates. The Contractor and supplier shall further be liable for any and all consequential damages which may result as a violation of this requirement.

(A) **GENERAL.** Coarse aggregate for use in bituminous mixtures shall be crushed stone. Materials shall have bulk dry specific gravity greater than 2.88 in order to be classified as trap rock. Coarse aggregate for surface course shall be trap rock or other non-polishing

igneous rock. The portion of the total aggregate passing the No. 4 sieve shall have a sand equivalent value of not less than 35 when tested in accordance with AASHTO T 176. The portion of aggregate retained on the 9.5 mm (3/8") sieve shall not contain more than 15 percent of particles by weight so flat or elongated, or both, that the ratio between the maximum and the minimum dimensions of a circumscribing rectangular prism exceeds 5:1. Coarse aggregate for bituminous concrete shall conform to the following:

Abrasion by Use of Los Angeles Machine	
Percentage of Wear, maximum	40
Soundness, Weighted Average, Percent Loss,	
Maximum, 5 cycles, Magnesium Sulfate	15
Total Material finer than No. 200 sieve (AASHTO T 11), maximum by weight	
Material which contains clay or shale	1.0
Material free of clay or shale	1.5

After first dry sieving on the No. 200 sieve in accordance with AASHTO T 27, the adherent coating on coarse aggregate as tested in accordance with AASHTO T 11 shall not exceed 1 percent.

**(B) COARSE AGGREGATE FOR BITUMINOUS SURFACE COURSES.** Coarse aggregate for bituminous surface courses shall conform to the quality requirements of 803.04(A) and aggregates containing a substantial portion of serpentine or talc minerals or carbonate aggregates containing less than 25 percent by weight insoluble residue, as determined by in sizes No. 200 to No. 10, shall not be used in surface course mixes. Shale and other material susceptible of polish shall not be used.

**(C) COARSE AGGREGATE FOR BITUMINOUS BASE AND BINDER COURSES.** Coarse aggregate for bituminous base and binder courses shall conform to the quality requirements of 803.04(A).

**803.05 MINERAL FILLER FOR BITUMINOUS CONCRETE**

Mineral filler shall be limestone dust, hydrated lime or portland cement meeting the requirements of AASHTO M 17.

Fly ash shall not be used as mineral filler unless approved by the Chief Engineer. The mineral filler shall be uniformly graded, non plastic, free from lumps or balls or any foreign materials and shall have a moisture content of not more than 0.5 per cent when incorporated into the bituminous mixture.

Mineral filler shall be graded within the following limits:

Sieve Designation	Percent Passing By Weight
No. 30	100
No. 50	95-100
No. 200	70-100

**803.06 FINE AGGREGATE FOR MASONRY MORTAR**

- (A) Fine aggregate shall meet the requirements of AASHTO M 45. It will be uniformly graded from fine to coarse within the following limits:

Sieve Designation	Percent Passing By Weight
No. 4	100
No. 8	95-100
No. 100	5-25
No. 200	0-10

- (B) Fine aggregate for mortar bond test behind ceramic wall tile shall be standard Ottawa sand passing the No. 20 sieve and retained on the No. 30 sieve.
- (C) **SAND.** Sand for use in ceramic tile mortar for scratch and float coat shall be clean washed sand and shall be composed of hard, strong, durable, clean grains, free from soft or flaky particles, shale, foam, alkali, organic matter, and other deleterious substances. It shall contain not more than 3 percent of silt by weight as determined by decantation. Sand subjected to the colorimetric test for organic impurities and producing a color darker than the standard (Organic Plate No. 3) sand shall be rejected. Sand shall be uniformly graded from coarse to fine within the following limits and in addition shall have a fineness modulus of not less than 1.90 nor more than 2.50:

Sieve Designation	Percent Passing By Weight
No. 4	100
No. 8	95-100
No. 16	65-90
No. 30	45-75
No. 50	10-35
No. 10	0-10

**803.07 LIGHTWEIGHT AGGREGATE FOR STRUCTURAL CONCRETE**

Lightweight aggregate for structural concrete shall meet the quality requirements of AASHTO M 195.

Lightweight fine aggregate shall meet the grading requirements of AASHTO M 195, Grading No. 4 to 0.

Lightweight coarse aggregate shall meet the grading requirements of AASHTO M 195, Grading No. 3/4 inch to No. 4.

The absorption value of coarse aggregate shall not exceed 10% in 24 hours.

**803.08 AGGREGATE FOR SLURRY SEAL**

Aggregate for slurry seal shall meet the quality requirements of 803.03(A). When combined with mineral filler, the mineral aggregate mix shall meet the following gradation:

<b>Sieve Designation</b>	<b>Percent Passing By Weight</b>
3/8 inch	100
No. 4	85-100
No. 8	65-90
No. 16	45-70
No. 30	30-50
No. 50	18-30
No. 100	10-21
No. 200	5-15

**803.09 AGGREGATE FOR BITUMINOUS SURFACE TREATMENT**

Coarse aggregate for bituminous surface treatment shall be crushed stone or crushed blast furnace slag and shall conform to the quality and grading requirements of 803.04(B) and as shown below:

<b>Sieve Designation</b>	<b>Percent Passing By Weight</b>
1/2 inch	100
3/8 inch	85-100
No. 4	10- 30
No.8	0- 10
No. 16	0- 5

For shoulder treatment, aggregate shall be light colored crushed stone. The Contractor shall submit to the Chief Engineer samples of aggregate from at least 3 different sources so that color selection may be made.

**803.10 AGGREGATE FOR RIPRAP**

Aggregate for riprap shall be field or quarry stone of approved quality and may be certified from a source previously approved. Maximum dimension shall not exceed four times the minimum dimension. Stone or grade aggregate from a quarry producing aggregate of asbestos content or having asbestos present at the quarry are prohibited.

Stone for riprap shall be uniformly graded from the smallest to the largest pieces as specified on the Contract Drawings. The stone will be accepted upon visual inspection at the point of usage, and shall conform to the following;

<b>Class of RIPRAP</b>	<b>Size</b>	<b>Percent of Total (by weight)</b>
0	Heavier than 33 lbs	0
	Heavier than 10 lbs	50
	Less than 1 lbs	10 max
	Heavier than 150 lbs	0
	Heavier than 40 lbs	50
	Less than 2 lbs	10 max
II	Heavier than 700 lbs	0
	Heavier than 200 lbs	50
	Less than 20 lbs	10 max
III	Heavier than 2000 lbs	0
	Heavier than 600 lbs	50
	Less than 40 lbs	10 max

**Note:** Optimum grading is 50 % of stone being above and 50% below the midsize. Reasonable Tolerances will apply.

**TABLE 803.02-1**  
**GRADING REQUIREMENTS FOR COARSE AGGREGATES**  
 (Total percent passing square mesh sieve)

AASHTO M43 <sup>1</sup>	3 Inch (75mm)	2-½ Inch (63mm)	2 Inch (50mm)	1-½ Inch (37.5mm)	1 Inch (25mm)	¾ Inch (19mm)	½ Inch (12.5mm)	¾ Inch (9.5mm)	No. 4 (4.75mm)	No. 8 (2.36mm)	No. 16 (1.18mm)	No. 50 (1.00mm)
2	100	90-100	35-70	0-15		0-5						
3		100	90-100	35-70	0-15		0-5					
4		100	100	90-100	20-55	0-15	0-5	0-5				
6					100	90-100	20-25	0-15	0-5			
7					100	100	90-100	40-70	0-15	0-5		
8						100	100	85-100	10-30	0-10	0-5	
9								100	85-100	10-40	0-10	0-5
10								100	85-100			10-30 <sup>2</sup>
57				100	95-100		25-60		0-10	0-5		
67				100	100	90-100		20-55	0-10	0-5		
68				100	100	90-100	90-100	30-65	5-25	0-10	0-5	
78					100	100	90-100	40-75	5-25	0-10	0-5	
89							100	90-100	20-55	5-30	0-10	0-5

<sup>1</sup> Same designations as Simplified Practice Designations

<sup>2</sup> No. 100 Sieve (0.50mm)

**804 AGGREGATES FOR SOILS AND BASE COURSE CONSTRUCTION****804.01 GENERAL**

Samples of excavated trench and embankment material, borrow fill material for trenches and embankments, and sub grade gravel shall be submitted by the Contractor to the Chief Engineer with test results. Soils shall be free from snow, ice, frozen materials, trash, brick, clay lumps, broken concrete, tree roots, sod, ashes, cinder, glass, plaster, vegetable matter and any other foreign matter.

The Chief Engineer will approve or disapprove the material based on the test results submitted or have analyses made on excavated material prior to use of excavated material as backfill. For excavated trench material, a minimum of one analysis will be made for each 500 feet of trench.

Sampling will be performed in accordance with AASHTO T 2; the sample shall be prepared in accordance with AASHTO T 27 and AASHTO T 88; the percentage of wear shall be determined in accordance with AASHTO T 96. The liquid limit shall be determined in accordance with AASHTO T 89; and the plasticity index shall be determined in accordance with AASHTO T 90.

**804.02 EMBANKMENT BACKFILL**

Material used in embankments shall meet the following specifications and may be rejected on visual inspection pending the testing of representative samples. No gravel or stone shall be larger than 3 inches in any dimension. The material shall have at least 10 percent, but not more than 35 percent, by weight, passing the No. 200 sieve. The soil shall have a liquid limit of not greater than 40 and a plasticity index of 6 to 15 inclusive. In confined embankment areas, the minimum plasticity index need not apply. Compaction of materials for embankment fill shall meet the density requirements per 203.03.

**804.03 BLANKET SOIL**

Blanket material shall consist largely of clays or mixtures of silts and clays that when compacted will present a relatively impervious surface to prevent the entrance of water. In no case shall it be principally composed of sands or coarser material. Liquid limit shall be a minimum of 50 and plasticity limit index shall be a minimum of 20. Permeability shall be a minimum of  $10^{-6}$  cm/sec.

**804.04 BASE COURSE AND/OR STRUCTURAL BACKFILL**

Material approved for use as a base course shall have a minimum CBR of 25 (AASHTO T 193) when prepared in accordance with AASHTO T 180-Method D.

- (A) **CRUSHED STONE BASE.** Crushed aggregate shall consist of crushed stone having hard, strong, durable particles, and conforming to the applicable requirements of AASHTO M147 for Bases.

Additional fine aggregate shall consist of material of the same type and quality as specified above for the coarse aggregate. The use of soil fines or natural sands will not be permitted.

The coarse aggregate and additional fine aggregate shall be so proportioned as to produce a final mixture meeting the following gradation requirements, including the tolerances:

Sieve Designation	Percent Passing by Weight	Job Mix Tolerances (Percent Passing by Weight)
2 inch	100	- 2
1-1/2 inch	95-100	+ or - 5
3/4 inch	70-92	+ or - 8
3/8 inch	50-70	+ or - 8
No. 4	35-55	+ or - 8
No. 30	12-25	+ or - 5
No. 200	0-8	+ or - 3

- (B) RECYCLED CRUSHED CONCRETE FOR BASE.** Recycled crushed concrete may be used in lieu of base material only if specified in the contract documents.

Materials of this type for use in base course shall meet the following specification requirements.

The combined aggregate for this use shall consist of crushed concrete or mortar, crushed stone, and crushed or uncrushed sand and gravel. Materials that break up under alternate freezing and thawing or wetting and drying shall not be used.

Coarse aggregate retained on the No. 10 sieve shall have a percentage of wear of not more than 50 in accordance with AASHTO T 96 and should have a minimum California Bearing Ratio of 25.

The fraction passing the No. 200 sieve shall not be greater than 2/3 of the fraction passing the No. 40 sieve. The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 6.

The composite material shall be free from organic matter, asphalt, bricks, lumps or balls of clay and other non-concrete material, and shall conform to the following grading requirements, including the tolerances:

Sieve Designation	Percent Passing By Weight	Job Mix Tolerances Percent Passing By Weight
2-1/2 inch (63mm)	100	-2
2 inch (50mm)	90-100	±5
3/4 inch (19mm)	60-90	±8
No. 4 (4.75mm)	30-60	±8
No. 10 (2.00mm)	20-45	±6
No. 40 (0.425mm)	10-30	±5
No. 200 (0.075mm)	4-12	±3

(C.) **SLAG FOR BASE COURSE.** The quality and grading requirements for slag used as a base course shall conform to 804.04(A).

#### 804.05 TRENCH BACKFILL

Material used in trench backfill shall be a well graded soil- aggregate mixture with ten percent, but no more than 35 percent, by weight, passing the No. 200 sieve. The soil shall have a liquid limit not greater than 40 and a maximum plasticity index of 10. Recycled crushed concrete may be used in lieu of trench backfill if approved by the Chief Engineer.

Within one foot of the pipe, no gravel or stone shall be larger than 1-1/2 inches in any dimension.

For remainder of trench, no gravel or stone shall be larger than four (4) inches in any dimension, and not larger than one inch within two feet of finish grade.

Backfill shall be free from snow, ice, frozen materials, trash, brick, clay lumps, broken concrete, tree roots, sod, ashes, cinders, glass, plaster, organic matter and any other foreign matter.

Backfill shall have a minimum dry weight density of 100 pounds per cubic foot.

Backfill shall have a uniform moisture content suitable for compaction to the specified density. The Contractor shall moisten or dry soils materials to obtain a suitable, uniform moisture content. If the materials are of such nature that heaving, pumping, rutting, or shearing occurs in the compacted backfill under the action of construction equipment, even though soil meets density requirements, affected material shall be replaced to limits as directed.

#### 804.06 TRENCH SUBGRADE GRAVEL

Gravel to backfill trench undercut areas shall be per AASHTO M-43, Grading Size No. 57.

#### 804.07 FLOWABLE BACKFILL

(A) **DESCRIPTION.** This work shall consist of placing flowable backfill in lieu of compacted soil or aggregate backfill in underground utility lines.

(B) **MATERIALS.** Materials used in flowable backfill shall conform to the requirements of the following specifications and standards:

Hydraulic Cement - 801.01.

Fly Ash - AASHTO M 295, Class F.

Water - 822.01.

Aggregates - 803.01.

Admixtures - 814.04 and 814.05.

Do not use calcium accelerators with fly ash.

- (C) **MIX DESIGN.** The mix design for flowable backfill shall be provided by the Contractor. Flowable backfill shall have a design compressive strength of 50 to 150 psi. at 28 days when tested in accordance with AASHTO T23. The Contractor shall be responsible for providing a flowable mixture using these guidelines and adjusting the mixture design as called for by circumstances or as may be directed by the Chief Engineer. The Contractor shall submit a mix design for approval supported by laboratory test data for one (1), three (3) and twenty eight (28) day compressive strengths. The mix design shall be approved by the Chief Engineer prior to beginning work.
- (D) **CONSTRUCTION.** Mixing and transporting shall be in accordance with Section 501 or by other methods approved by the Chief Engineer.

When used as backfill for pipe and floatation or misalignment occurs, correct alignment shall be assured by means of straps, soils anchors or other approved means of restraint.

- (E) **MEASURE AND PAYMENT.** The unit of measure for Flowable Backfill will be the cubic yard, complete in place. Payment for Flowable Backfill will be made at the contract unit price per cubic yard, which payment shall include furnishing and placing flowable backfill and for all materials, labor, tools, equipment and incidentals necessary to complete the work.

When not shown as a pay item in the contract documents, flowable backfill will be measured as specified above; however, it will be considered as a substitution for the appropriate item and payment will be made at the contract unit price per cubic yard for that item. Such price shall be full compensation for furnishing and placing flowable backfill and for all materials, labor, tools, equipment and incidentals necessary to complete the work.

## **805 AGGREGATES FOR DRAINAGE**

### **805.01 GENERAL**

Aggregates shall be free from snow, ice, frozen materials, trash, brick, clay lumps, broken concrete, tree roots, sod, ashes, cinder, glass, plaster, organic matter and any other foreign matter.

### **805.02 FINE AGGREGATE FOR PERVIOUS FILL**

Material for use in underdrains and pervious backfill shall consist of a well graded mixture of crushed or natural fine gravels and coarse sands conforming to the following grading requirements:

<b>Sieve Designation</b>	<b>Percent Passing By Weight</b>
3/8 inch (9.5 mm)	100-100
No. 4 (4.75 mm)	95-100
No. 16 (1.18 mm)	45-80
No. 50 (0.300 mm)	10-30
No. 100 (0.150 mm)	2-10
No. 200 (0.075 mm)	0-3

Foundry sand, crushed stone, or other material which may be cementitious or are not suitable for water percolation shall not be used.

### **805.03 COARSE AGGREGATE FOR UNDERDRAIN**

Coarse aggregate for bedding and encasement of pipe shall be grading No. 57 or No. 67 Crushed Stone/Gravel of Table 803.02-1 and be an inert material.

### **805.04 BLANKET SOIL FOR UNDERDRAIN**

See 804.03.

**806 MASONRY UNITS****806.01 CLAY OR SHALE BRICK**

Color shall be as specified in the contract documents.

- (A) **SEWER BRICK.** Sewer brick shall meet the physical requirements of AASHTO M 91, Grade MS for manholes and Grade SS for invert surfaces, and shall be 2-1/4 x 3-3/4 x 8 inches in size.
- (B) **SIDEWALK BRICK.** Sidewalk brick shall meet the requirements of ASTM C 902, Class SX, Type 1.
- (C) **BUILDING BRICK.** Building brick shall meet the requirements of AASHTO M 114, Grade SW.
- (D) **GUTTER BRICK.** Gutter brick shall meet the physical requirements of AASHTO M 91, Grade SS, and shall be of a size as specified. The exposed face of brick shall be smooth.
- (E) **ALLEY AND ALLEY DRIVEWAY BRICKS.** Alley bricks shall meet the requirements of ASTM C 1272, Grade PX and shall meet the requirements of Table One physical requirements. Bricks shall be 8"x4"x2.75 " minimum depth and shall be tested for efflorescence.

**806.02 PRESSED CONCRETE BLOCK PAVERS**

Pressed Concrete Block Pavers shall have a non-slip or stipple finish. Large, rough, exposed aggregate surfaces are not acceptable. All top edges of pavers shall have a 3/16 inch bevel. The color shall be natural limestone gray or as approved by the Chief Engineer. The pavers shall also meet the following requirements.

- (A) **SIZE.** Sidewalk pavers shall be 24 x 36 x 2 inches (nominal) or metric equivalent. Driveway pavers shall be 8 x 4 X 3 inches or metric equivalent. Pavers shall have a tolerance of +/- 1/16 inch in length and width and +/- 1/8 inch in thickness.
- (B) **COMPRESSIVE STRENGTH.** Average compressive strength of four 2 x 2 x 2 inch cubes or 2 inch diameter cylindrical cores obtained from two pavers per lot shall be 5000 psi minimum as tested by AASHTO T 32.
- (C) **WATER ABSORPTION.** Maximum 24 hour cold water absorption shall be less than 5 percent tested in accordance with AASHTO T 32, Section 8, except that 4 specimens will be tested.
- (D) **FREEZING-THAWING RESISTANCE.** After 50 cycles of freezing and thawing, in accordance with AASHTO T 32, or, after a 3 day submersion in 3 percent sodium chloride solution, 1/2 inch deep over the top of the test specimen, weight loss shall be less than 3 percent with no visual signs of deterioration.

**806.03 CONCRETE BRICK**

Concrete brick shall conform to the composition and physical requirements of for the weight, type and grade specified.

**806.04 GLAZED CERAMIC TILE**

- (A) **GENERAL.** All tile shall be glazed ceramic wall tile of the sizes and shapes specified herein and as shown in the contract documents. The quality of the tile shall be standard and grade as defined in A1371.1 ANSI Standard Specification for Ceramic Tile.
- (B) **PHYSICAL PROPERTIES.** Tiles (other than trimmer tiles, angles, etc.) shall have a nominal size of 4-1/4 inches by 4-1/4 inches. The size of the tile shall not vary from the nominal 4-1/4 inch dimension by more than 3/64 inch. All tile shall be of a uniform thickness of not more than 1/2 inch nor less than 3/8 inch, including the projecting lugs or keys as specified in this section, and not less than 5/16 inch thick exclusive of said lugs or keys. They shall be graded for size into groups by the manufacturer for the Contractor, and each group shall be composed of one size tile varying not more than 1/32 inch. Each group of sizes shall be segregated and shipments shall be made in substantial quantities of one size.

The tiles shall have an approved cushion edge and the backs shall be free from glaze, glaze sheen or film. The edges shall be reasonably free from a glaze coating and shall not have drops or globules exceeding 1/64 inch in thickness. The body shall be free from concave warpage exceeding 0.2 per cent of the diagonal of the square and shall be free from convex warpage exceeding 0.3 percent of the diagonal. They shall be free from wedging or crooked edges exceeding 0.5 percent of the edge length and from other imperfections such as pressing cracks, dents, swelling, and chipping.

The Contractor shall provide approved equipment for checking tile for warpage, wedging and size. The equipment shall mechanically measure compliance or non-compliance of the tile with the specified limits of warpage and wedging and shall classify the tile as to size group.

Tiles shall be manufactured with projecting lugs or keys on the backs and with rough back surfaces so as to furnish a satisfactory mechanical bond with supporting mortar. The width of the back face of the lugs or keys shall be appreciably greater than the width at the base of the said lugs or keys. The lugs or keys shall project not less than 3/32 inch beyond the back face of the body of the tile and shall be of such pattern as to avoid closed pockets by which air might be entrapped within the mortar backing. If the tile is manufactured with projecting edge rims or borders on 2 or more adjacent sides, there shall be provided at least 2 slots on each side of the tile where said rims or borders occur so as to avoid entrapment of air within the mortar backing. These slots shall be not less than 5/16 inch in width and shall extend across the full width of the edge rims or borders and for the full depth of the edge rims or borders to the body of the tile. The pattern of the lugs or keys shall be subject to the approval of the Chief Engineer.

The face of the tile shall be a glazed finish with a semi- matte texture having a specular gloss factor of 21 to 70 units when determined as specified herein. The glazed surface shall be smooth, easily cleaned and free from all imperfections or injurious defects such as waviness, pinholes, specks, spots, blisters, feathering, crawling, crazing, chipping, scumming, discoloration or sanding to an extent which would affect the appearance of the tile. The daylight luminous directional reflectance when measured as specified herein shall be a minimum of 70 percent. The light reflectance requirements do not apply to the darker tile as used for trim.

The color of the tile shall be as specified in the contract documents, and samples of tile having the required finish, texture and color shall be submitted to the Chief Engineer for approval. These samples shall have the following identification: "Samples of Glazed Ceramic Wall Tile Illustrating Finish, Texture and Color Only."

- (C) **SAMPLING.** During progress of the work, the Contractor shall furnish at his own expense as many samples lots of tile as may be required for testing. A sample lot shall consist of 30 tiles. Samples of the tile for test purposes will be selected by the Chief Engineer from tile delivered to the project and shall be identified as a lot. On each project, a sample lot of tile shall be obtained and tested prior to start of tile construction irrespective of the quantity of tile facing involved. On projects involving less than 25,000 square feet of tile, additional samples and testing shall be at the option of the Chief Engineer.

In case the sample from any one lot of tile fails to meet the requirements of these specifications, an additional sample from the same lot will be selected and subjected to the prescribed tests. Should the additional sample also fail to meet specification requirements, the entire lot so represented will be rejected. Rejected tile shall be promptly removed from the job site and disposed of and shall not be used or submitted again for inspection or test.

- (D) **TESTING.** The Contractor shall secure certified results of tests from the manufacturer indicating that the tile being furnished on the project conforms in all respects to the requirements specified. Sampling of tile delivered to the project will be performed as provided herein. Sample lots tested shall meet the requirements of the tests listed below. The tests specified for dimensions, warpage and light reflectance are non-destructive and tiles used for these tests shall also be used for the remainder of the tests.

- (1) **DIMENSIONS.** Five tiles shall be selected at random from the sample lot consisting of 30 tiles and tested for conformance to the requirements specified for dimensions. When so tested, the dimensions for the 5 specimens shall be within the tolerances specified.
- (2) **WARPAGE.** Five tiles shall be selected at random from the sample lot and tested for conformance to the warpage requirements. When so tested, the warpage of the 5 specimens shall be within the tolerances specified.
- (3) **SPECULAR GLOSS AND LIGHT REFLECTANCE.** Five tiles shall also be selected at random for the specular gloss and light reflectance tests. The specular gloss shall be determined in accordance with ASTM D 523, 60 degree Geometry Method. The daylight luminous directional reflectance shall be measured by a Gardner (Hunter design) Color and Color Difference Meter, operated in accordance with manufacturer's instructions. When so tested, the specular gloss and light reflectance of the 5 tiles shall conform to the requirements.
- (4) **ABSORPTION.** A sample consisting of 5 tiles shall be dried in an oven for two hours at 110°C, cooled to room temperature and weighed separately on a scale sensitive to 0.5 gram. The dry tiles shall then be placed in water at a temperature of 15 to 30°C. The water shall be boiled for two hours and permitted to cool gradually to within 15°C to 27°C. The tiles shall be removed from the water 24 hours after the initial immersion, their surfaces wiped dry with a clean damp cloth and quickly

weighed separately. The percent absorption of each specimen shall be calculated on the basis of its weight.

The average water absorption of the 5 specimens tested shall not exceed 2 percent. The water absorption of any individual specimen shall not exceed 2-3/4 percent

- (5) **CRAZING.** An autoclave with sufficient capacity to contain not less than 5 tiles shall be used. The apparatus shall be equipped with a safety valve, blow-off valve, pressure gauge whose accuracy is within 2 percent of the scale range, and a burner of sufficient capacity to insure a constant steam pressure. A sufficient amount of water shall be placed in the autoclave so that after a one hour test at 200 pounds steam pressure, a slight excess of water will remain. The sample consisting of 5 or more tiles shall be loosely placed on edge in a suitable wire container above the water line within the autoclave at room temperature. The autoclave head shall then be securely fastened in place.

The water in the bottom of the autoclave shall be heated from an external source. The blow-off valve shall be kept open until steam begins to escape, thereby expelling most of the air. After closing the blow-off valve, the water shall be kept boiling and the steam pressure increased at a uniform rate until 200 psi is reached within a period not exceeding one hour. Sufficient heat shall be applied to maintain a constant steam pressure of 200 pounds per square inch for an additional hour. The burner shall then be shut off and the steam pressure immediately released by opening the blow-off valve. The autoclave head shall be loosened but not removed until the specimens have cooled slowly to room temperature and a washable black ink rubbed upon their surfaces to aid in the detection and examination of failure.

After being subjected to 5 consecutive cycles of the foregoing crazing test, the 5 tiles tested shall show no crazing, chipping, spalling or cracking of either the body or glaze. The glazed surface of the tile shall show no permanent clouding, dulling or pitting. Slight dull streaks will be permitted provided they do not comprise more than 20 percent of the glazed surface area.

- (6) **THERMAL SHOCK.** A sample consisting of 3 tiles shall be placed in an oven at room temperature. The temperature within the oven shall then be uniformly raised to 110°C in a period of one hour, and maintained at the temperature for an additional hour after which each specimen shall be removed from the oven and immediately plunged into a mixture of ice and water having a temperature of not more than 2°C. At the end of 10 minutes, each specimen shall be removed from the water mixture and a washable black ink applied upon the glazed surfaces and bodies to aid in the detection and examination of failures.

After being subjected to 5 consecutive cycles of the foregoing thermal shock test, the 5 tiles shall show no crazing, chipping, spalling or cracking of either the body or glaze.

- (7) **WEATHERING.** A sample consisting of 5 tiles shall be placed in water at room temperature. The water shall then be boiled for a period of 2 hours and permitted to cool gradually to room temperature. The specimens shall then be removed from the water and their surfaces wiped dry with a clean damp cloth. Immediately thereafter they shall be placed in a freezing chamber (not immersed in water) for a period of 4

hours. The freezing chamber shall be maintained at a temperature below minus 12°C. The specimens shall then be removed from the freezing chamber and immediately immersed in water at room temperature. After the specimens have completely thawed in the water, they shall be removed, their surfaces wiped dry with a clean damp cloth, and a washable black ink rubbed upon their surfaces to aid in the detection and examination of failures. After being examined, the five tiles shall again be immersed in water until such time as is convenient to again place them in the freezing chamber for the additional cycles of the weather test.

After being subjected to 5 consecutive cycles of the foregoing weather test, the 5 tiles tested shall show no crazing, chipping, spalling, or cracking of either the body or glaze.

- (8) **GLAZE HARDNESS.** A sample consisting of 5 tiles shall be used in the glazed hardness test utilizing the Moh Scale of minerals. A piece of mineral having a hardness of 4 as measured by the Moh Scale shall be slowly drawn across the glazed surface of each specimen with a steady, uniform pressure of approximately 25 pounds. When subjected to the above test, the glazed surface of the 5 tiles shall not show a scratch.
- (9) **BOND.** Before the design of the back of the tiles is approved, the tile shall meet the following requirements: This test will be performed only on the sample of tile obtained prior to start of tile construction.

A layer of mortar shall be placed in the bottom of 5 molds of a thickness of one inch. The mortar shall contain the following, by weight of mix:

Portland Cement-801.01(D) - 1 part

Sand-803.06(B) - 2-1/2 parts

Hydrated Lime-822.03 (E) - 16-1/2 parts by weight of cement

The inside dimension of the molds shall be 4-3/8 inches square and 1-1/8 inches in depth. The tiles shall be thoroughly wetted following which a skim coat of neat portland cement shall then be spread evenly on the back of each tile, filling all spaces between lugs or keys, to a thickness not exceeding 1/8 inch prior to setting the tile on the mortar. The tile shall be firmly pressed or tapped into place and the bond test specimen consisting of mold, mortar and tile shall be stored in a normal atmosphere at room temperature for 7 days until tested for strength of bond in shear in a suitable compression machine at a rate of load of 2400 pounds per minute. The average strength of bond in shear of the specimen shall not be less than 225 pounds per square inch.

### 806.05 MORTAR MIXTURES

(A) **GENERAL.** Materials used in mortar mixtures shall conform to the following:

- (1) Masonry Cement - 801.02
- (2) Portland Cement - 801.01
- (3) Hydrated Lime - 822.03(D)
- (4) Fine Aggregates - 803.06

- (5) Sand - 803.06(C)
- (6) Water - 822.01
- (7) Epoxy – 822.08

**(B) PORTLAND CEMENT MORTAR MIX.**

- (1) Mortar for stone masonry (setting) shall be composed of one part portland cement, 3 parts fine aggregate by volume and hydrated lime in an amount equal to 10 per cent of the cement by weight.
- (2) Mortar for stone masonry (pointing) shall be composed of one part dark portland cement and 2 parts fine aggregate to which sufficient hydrated lime may be added to make as stiff a mixture as can be properly worked with a caulking tool.
- (3) Mortar used for scratch and float coat in ceramic tile construction shall be composed of 1 part portland cement and 2-1/2 parts sand meeting 803.06(C) and 1/5 part hydrated lime (slaked 24 hours minimum before use).
- (4) Joint mortar for sewer pipe and valve casings shall consist of one part Type II Portland cement and 2-1/4 parts fine aggregate by volume thoroughly mixed dry, and sufficient water to make a stiff mix.
- (5) Joint and parging mortar for manhole brickwork shall consist of one part Type II Portland cement and 2-1/4 parts fine aggregate per 803.06(A) by volume and sufficient water to make a stiff mix. Lime in mortar is prohibited.

**(C) EPOXY MORTAR.** Epoxy mortar shall be composed of sand conforming to 803.06(A) and epoxy conforming to 822.08 and proportioned by volume as follows:

<b>Parts Sand-Dry (by volume)</b>	<b>Parts Epoxy (by volume)</b>
1	3 to 4 with Grade 1 Epoxy
1	2 to 3 with Grade 2 Epoxy
1	1 to 1-1/2 with Grade 3 Epoxy

Type and class of epoxy and proportions of sand to epoxy shall be per 822.8(C).

- (D) MASONRY CEMENT MORTAR MIX.** Masonry mortar shall be composed of one part masonry cement and two parts fine aggregate by weight.
- (E) NONSHRINK GROUT.** Nonshrink grout shall be premixed, nonmetallic, non corrosive, nonstaining product containing silica sands, portland cement, shrinkage compensating agents, and plasticizing and water-reducing agents. The hardened grout shall obtain 6000 psi minimum compressive strength at 28 days when tested in accordance with. The shrinkage shall not exceed 0.00 inches in plastic state when tested in conformance with and in hardened state when tested in accordance with ASTM C1107.
- (F) NONSHRINK GROUT FOR SEWER-WATER WORK.** Nonshrink grout for sewer-water work shall be premixed, non-metallic, non-corrosive, non-staining product containing silica sands, portland cement, shrinkage compensating agents, and plasticizing and water-reducing agents.

The Contractor shall furnish recent independent laboratory tests showing compliance with requirements specified. Certification or affidavits will not be acceptable.

The Contractor shall furnish manufacturer’s literature describing product and instructions for use.

Grout shall be delivered in moisture proof bags with the manufacturer’s name, product name and general instructions for placement printed on the bag.

The product shall be stored on pallets and protected from moisture and damage.

All grout shall be non-metallic, non-shrink, non-gas forming, pre-blended and ready-for-use requiring only the addition of water.

- (1) Grout shall contain no metals nor rust or corrosion promoting agents, or gypsums.
- (2) The addition of set control agents or water reducers shall not be allowed.
- (3) Grout shall conform to the following properties:

Property	Test Methods	Requirements
Shrinkage below Placement Volume		0
Drying Shrinkage	ASTM C596	0
Expansion	ASTM C596	0.10 max.
Compressive Strength*		
24 hours	3,000 psi min.	AASHTO T 106
7 day	6,000 psi min.	AASHTO T 106
Initial Set Time	#5 bar grouted	Min. 45 minutes
Pull-Out Strength	6” deep in a 7/8” dia. Hole in saturated surface dried concrete	10,000 lbs.

\*Flowable mix

Water shall be clean and free from injurious chemicals and deleterious materials.

## 807 JOINT MATERIALS

### 807.01 PREFORMED EXPANSION JOINT FILLER

- (A) **FOR USE IN PAVEMENT CONSTRUCTION.** Preformed expansion joint for use in PCC pavement, base, sidewalk, curb and gutter construction and sewer-water structures shall meet the requirements of AASHTO M 153, Type II (Cork).

Preformed joint material shall be new material for all work and furnished in longest lengths practicable for intended use as determined by the Chief Engineer, and in no case shall joint material be furnished in lengths less than 10 feet. Pieces for curb and gutter and as directed shall be cut in exact size from larger furnished sections. All splices in joint material shall be carefully made to insure against penetration of PCC between adjacent strips of joint material. Joint material shall neither be furnished nor stored in rolls.

When dowel bars or other approved load transfer devices are specified, the preformed filler shall have holes of the proper diameter or size drilled through it at the specified intervals to receive the bars and to insure a tight fit.

- (B) **FOR USE IN STRUCTURES.** Preformed expansion joint filler for use in structures shall meet the requirements of AASHTO M 153, Type II or III (Cork or Self-expanding Cork). Premolded joint fillers shall be of suitable length to minimize splices and of proper width to eliminate field cutting longitudinally.

### 807.02 JOINT SEALING MATERIALS

#### (A) HOT-POURED TYPE.

- (1) **JOINT AND CRACK SEALANT FOR PORTLAND CONCRETE AND ASPHALT PAVEMENTS.** Hot applied type sealant for use in sealing joints and cracks in PCC and asphaltic concrete pavements shall meet the requirements of AASHTO M324-04, Type 11.
- (2) **ELASTOMERIC JOINT SEALANTS.** Hot-poured elastomeric-type of one-component, hot-applied, concrete joint sealant for joints in slabs and walls shall meet the requirements of AASHTO M 282. Bond breaker shall be suitable polyethylene tape of correct width to suit conditions. The sealant manufacturer shall submit written certification that the sealant is resistant to acid (to pH of 3.5) and alkali (to pH of 8.5).
- (3) **FUEL-RESISTANT JOINT SEALANT.** Hot-poured sealant for use in sealing joints and cracks in PCC pavements subject to exposure to fuels shall meet the requirements of ASTM D 3569 or ASTM D 3581.

- (B) **CAULKING COMPOUND.** Caulking compound for structures shall meet the requirements of the ASTM C920.

### 807.03 LOAD TRANSFER ASSEMBLIES

- (A) **GENERAL.** The load transfer assembly for all transverse expansion and contraction joints shall be of a material and design approved prior to use. The assembly shall provide

means for transfer of load across the joint by use of dowels or other approved methods. Only the dowels shall cross the joint.

Load transfer assemblies shall be one of the types shown on the standard drawings or contract plans.

Dowels for expansion joints shall be provided with a sleeve meeting the requirements of 807.03(C).

The assembly shall be a single unit and of a length equal to the width of the slab being constructed. It shall be sufficiently rigid to hold each dowel in correct position and alignment with 1/8 inch in 12 inches and to support the weight of a man such that when the weight is removed, the dowels will be within the specified position and alignment. Assemblies fabricated for use with preformed expansion joint filler shall be constructed such that the filler will be firmly held in a vertical position and in a straight line during placement of concrete.

- (B) DOWEL BARS.** When dowel bars are used, they shall be plain rounded bars of the diameters and lengths as shown on the standard drawings or contract plans.

All dowels shall meet the requirements of AASHTO M 31, Grade 60. They shall be painted with paint conforming to the requirements of 811.03(E). When the paint has dried and immediately before the dowels are placed in position, the free end shall be thoroughly coated with an approved lubricant.

- (C) DOWEL SLEEVES.** Dowel sleeves shall be of the dimensions as shown in the contract documents and shall fit the dowel bar snugly. The dowel sleeves shall be capable of sliding over  $2 \pm \frac{1}{4}$  inches of the dowel. One end of the sleeve shall be closed so that concrete cannot enter. The sleeve shall be indented or have suitable flange at least 1 inch from the closed end to provide a limiting stop for the sleeve when being placed on the dowel bar and to insure subsequent free movement of the dowel in the sleeve. The sleeve shall be of such rigid design that the closed end will not collapse during construction.

- (D) METAL PLATES FOR TRANSVERSE CONTRACTION JOINTS.** Metal plates for use in curb and/or gutter sections shall be 14 gauge metal sheets, or other approved materials.

#### **807.04 TIE ROD ASSEMBLIES AND TIE RODS**

- (A) TIE ROD ASSEMBLY.** Tie rod assemblies shall be of the dimensions as shown in the contract documents.

The adapter shall be threaded internally such that the bars may be inserted therein, and shall be of such strength and design that it will conform to the strength requirements specified herein.

Tie rod assemblies shall conform to the requirements of AASHTO M 227, Minimum Grade 60. When tested in assembled condition in accordance with AASHTO T 244, the tie rod assembly shall conform to the tensile requirements of AASHTO M 227, Minimum Grade 60, based on the measured cross-sectional areas of the unthreaded portion of the bars.

- (B) **DEFORMED STEEL TIE RODS.** Tie rods shall be deformed bars, conforming to the requirements of AASHTO M 31, Grade 40.

### 807.05 WATERSTOPS

#### (A) NEOPRENE WATERSTOP

- (1) **DESCRIPTION.** Neoprene waterstops shall be manufactured from a vulcanized elastomeric compound containing neoprene as the sole elastomer. Manufacturer's shop splices shall be fully vulcanized.
- (2) **REQUIREMENTS.** The material for neoprene waterstops shall be tested as per 807.05(A)(3) and conform to the following:

<b>Physical Tests:</b>	<b>Requirements:</b>
Tensile Strength, psi	2,000 minimum
After aging, not less than	85 % of original
Elongation at Break, %	300 minimum
Ozone Resistance	No Crack

- (3) **METHOD OF TESTING.** Tensile Strength and elongation testing shall be in accordance with ASTM D412. The accelerated aging shall be in accordance with the requirements of ASTM D573 for 70 hours at 212 ° F. Ozone Resistance testing shall be in accordance with ASTM D1149 using 20% strain for 100 hours at 100° F±2 degrees.

#### (B) POLYVINYL CHLORIDE (PVC) WATERSTOP.

- (1) **DESCRIPTION.** Polyvinyl chloride waterstops shall be manufactured from polyvinyl chloride conforming to the Corps of Engineers Specification Number CRD-C 572 and shall conform to the ozone resistance as required for neoprene waterstops. A certificate shall be furnished with the test sample supplied stating that all of the performance requirements specified under paragraph 6 of the said specifications have been satisfied. Use of reclaimed PVC is prohibited.

**Water stop for water-sewer** structures shall be 9 inch dumbbell type for construction joints and dumbbell with center bulb for expansion joints.

All other waterstop shall be the size, shape, dimensions and tolerances as specified in the contract documents.

- (2) **SAMPLES.** A sample consisting of not less than 2 square feet shall be obtained from each type of finished waterstop proposed for use.
- (3) **SPLICES.** Field splices for polyvinyl chloride water stops shall be performed by heat sealing the adjacent surfaces in accordance with manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not char the plastic. Waterstops when being installed shall be cut and spliced at changes in direction as may be necessary to avoid buckling or distortion of the web or flange.

**807.06 COMPRESSION SEALS**

- (A) **PREFORMED EXTRUDED COMPRESSION SEALS.** Preformed extruded compression seals shall be the shape (angled and webbed) as specified in the contract documents and shall be composed per ASTM D 2628. Adhesive for use with this seal shall be one part moisture curing polyurethane and aromatic hydrocarbon solvent mixture with the following physical properties:

Average weight per gallon	8.00 lbs +/-10
Solids content	72-74 by weight
Adhesive shall remain fluid	5°F to 120°F
Film Strength (ASTM D 412)	1200 psi
Elongation (ASTM D 412)	350%
Low Temperature Strength (ASTM D 746) -60°C, tensile	1200 psi

Each lot of adhesive shall be delivered in containers plainly marked with the manufacturer's name or trade mark and date of manufacture and shall be accompanied by an affidavit at testing conformance with this article.

- (B) **O-RING SEALS** - O-ring compression seals for precast sewer manhole rings shall be per ASTM C361 or ASTM C443.

**807.07 TILE JOINT SEALANT**

Joint sealant for ceramic wall tile shall be as per manufacturer's recommendation.

## 808 NON METALLIC PIPE

### 808.01 PCC PIPE

- (A) **NONREINFORCED PCC PIPE.** Non-reinforced PCC pipe shall meet the requirements of AASHTO M 86 for the Class of pipe as specified in the contract documents.
- (B) **REINFORCED PCC PIPE.** Reinforced PCC pipe shall be of Class B PCC, Class III minimum, Wall B minimum for the diameter(s) specified in the contract documents and per AASHTO M 170 modified as follows:

PCC mix proportions shall be determined per 817.01(B) prior to production. PCC shall contain a minimum of 564 lbs. cement per cubic yard.

PCC pipe shall be furnished with rubber gasket joints per 808.04.

PCC pipe and joints for sanitary and combined sewers shall pass 13 psi hydrostatic test performed by pipe manufacturer per AASHTO M 315, Section 10, and ASTM C 497.

PCC pipe for building sewer connections and cleanouts shall be furnished with bell and spigot, rubber gasket joints as per AASHTO M 315. Joints shall pass 13 psi hydrostatic test.

The bevel or drop on bevel pipe shall not exceed the pipe wall thickness.

Except for closure sections and as otherwise specified, PCC pipe shall be furnished in minimum eight (8) foot lengths in sizes 12-inch through 72-inch diameter and minimum six (6) foot lengths in sizes larger than 72-inch diameter.

Branches and specials shall have standard reinforcement deflected to facilitate opening for the branch or special and shall be formed at time of pipe manufacture. Additional reinforcement shall be welded to longitudinal and circumferential steel where deflection or opening results in bar spacing in excess of one and one half times the wall thickness. The design and fabrication plan for branches and specials shall be submitted for approval prior to manufacture.

Pipe 12-inch through 72-inch diameter will be accepted from a manufacturer's existing stock provided crushing strength tests meet AASHTO M 170 requirements and, for sanitary and combined sewer, the pipe meets hydrostatic test requirements. Crushing tests shall be performed under the supervision of a District inspector on the manufacturer's testing machine.

Pipe 78-inch diameter and larger will be accepted based on tests of quality of the PCC as placed in the pipe and by examination of the quality, amount, and accuracy of placement of the steel reinforcement per AASHTO M 170 requirements and, for sanitary and combined sewer, the pipe meets hydrostatic test requirements.

### 808.02 POLYVINYL CHLORIDE (PVC) PIPE

- (A) **PVC PIPE.** Polyvinyl chloride (PVC) pipe and fittings for Pipe Sewer shall be per ASTM D 3034 SDR 35 for pipe up to 15-inches diameter, and ASTM F 679 and wall thickness T-1 for pipe 18 thru 27-inches diameter. Unless otherwise approved, lengths of

pipe sections shall not exceed 13 feet and lengths of Y-branches shall not exceed three (3) feet. Saddle Y-branches shall not be used.

Joints for both the pipe and fittings shall be of the integral bell type with integral wall section per ASTM D 3212. PVC pipe shall be furnished with elastomeric gasket seals per 808.04.

All pipe and fittings furnished shall be accompanied by a certification, per ASTM D 3034, which will be the basis of acceptance of the material. Pipe and fittings will be inspected upon delivery. Rejected pipe and fitting shall be removed by the Contractor.

- (B) **PVC PERFORATED PIPE.** Perforated PVC pipe and fittings shall meet the requirements of ASTM D 2729 with a dimension ratio (DR) of 35. Unless otherwise approved, lengths of pipe sections shall not exceed 13 feet and lengths of Y-branches shall not exceed three (3) feet. Saddle Y-branches shall not be used.
- (C) **PVC BUILDING CONNECTION PIPE.** Polyvinyl Chloride (PVC) pipe shall meet the requirements of ASTM D 2665. Unless otherwise approved, 20 foot lengths of pipe shall be used wherever practicable and lengths of wye-branches shall not exceed 3 feet. Saddle wye-branches shall not be used. Pipe and fittings will be inspected upon delivery. Rejected pipe and fittings shall be removed by the Contractor.

Pipe fittings and joints shall meet the requirements of ASTM D 3311. Joints shall be solvent welded with solvent cement meeting the requirements of ASTM D 2564.

- (D) **JOINT MORTAR.** Joint mortar for sewer pipe shall be per 806.05(B) (4).
- (E) **PIPE BEDDING.** Pipe bedding for sewer pipe shall be per AASHTO M 43, Size No. 57.

### 808.03 CLAY PIPE

Vitrified clay pipe and fittings for sanitary sewer shall be used only as directed and shall meet requirements of ASTM C 700, extra strength.

### 808.04 GASKETS

- (A) **GASKET, REINFORCED PCC PIPE.** Rubber gaskets for PCC pipe joints shall be per AASHTO M 315. Joints shall pass 13 psi hydrostatic test performed by pipe manufacturer. The bevel or drop on bevel pipe shall not exceed the pipe wall thickness.
- (B) **GASKET, POLYVINYL CHLORIDE TYPE.** Solid cross section elastomeric gasket seal shall be per ASTM F 477, factory assembled and securely locked or cemented in the socket.

## 809 METAL PIPE AND FITTINGS

### 809.01 DUCTILE IRON PIPE AND FITTINGS

#### (A) DUCTILE IRON PIPE.

- (1) Pipe shall be ductile-iron meeting the requirements of AWWA C151 with mechanical or push-on joints. Pipe shall be asphaltic coated outside and cement lined with double thickness and seal coated in accordance with AWWA C 104. Pipe shall be furnished in lengths of 18 to 20 feet and shall include all joining materials.
- (2) Unless otherwise specified, outside diameter of ductile-iron plain end shall be the same as for mechanical-joint cast or ductile-iron pipe.
- (3) Wall thickness class shall be per Table 809-1 unless otherwise specified on Contract Drawings.
- (4) Fittings or pipe not properly identified for pressure class, thickness or weight as required by ANSI/AWWA Standard C 110, C 151, or C 153 shall not be used.

**TABLE 809-1  
DUCTILE-IRON PIPE WALL THICKNESS AND PRESSURE CLASSES**

Diameter (Inches)	Pressure (psi)	Pressure Class <sup>1</sup>	Special Thickness Class <sup>2</sup>	Thickness (Inches)
6	350	--	52	0.31
8	350	--	52	0.33
12	350	--	52	0.37
16	350	--	51	0.37
20	350	350	--	0.38
24	300	300	--	0.40
30	200	200	--	0.38
36	200	200	--	0.42
42	200	200	--	0.47
48	200	200	--	0.52
54	200	200	--	0.58
60	200	200	--	0.61

<sup>1</sup>Pressure classes are defined as the rated water working pressure of the ductile-iron pipe in psi.

Rated water working pressure for ductile-iron pipe calculations are based on a 2.0 safety factor times the sum of the working pressure indicated for each nominal size plus a surge allowance of 100 psi as per AWWA C 150.

<sup>2</sup>Special thickness classes were designated as standard thickness classes prior to 1991.

**(B) JOINTS AND FITTINGS – DUCTILE IRON PIPE.**

- (1) Mechanical and push-on joints for ductile iron water main pipe shall be per AWWA C 111.
- (2) Fittings 48 inches and smaller in diameter shall be mechanical bell joint, ductile-iron in accordance with AWWA C 110, including dimensions and weights.
- (3) Fittings 54 inches and larger in diameter shall be push-on ductile-iron proprietary restrained joints in accordance with AWWA C 153.
- (4) Coatings for Fittings :
  - (a) Provide exterior asphaltic coating per AWWA C-110 and interior cement-mortar lining as per AWWA C-104, or
  - (b) Provide interior and exterior fusion bonded epoxy coating, 6-8 mils in thickness, conforming to AWWA C-116.
- (5) All fittings shall be complete with all joint accessories, rubber gaskets, bolts and nuts.

**(C) JOINT RESTRAINT, DUCTILE IRON PIPE.**

- (1) Unless otherwise noted, pressure ratings for pipe harnessing components shall not be less than the pipe working pressures shown in Table 809-1 for each size of pipe.
- (2) Push-on ductile-iron pipe with proprietary restraint shall be as follows:
  - (a) For pipe 36 inches and smaller in diameter; “Flex-Ring Joint Pipe” by American Cast Iron Pipe Company, or “TR-Flex Pipe”, by U.S. Pipe and Foundry Company.
  - (b) For pipe 42 inches and larger in diameter: “Lok-Ring Joint Pipe” by American Cast Iron Pipe Company, or “TR-Flex Pipe”, by U.S. Pipe and Foundry Company.
- (3) Retainer glands for restraint of mechanical joint, ductile-iron pipe 24 inches and smaller in diameter shall be designed to fit standard mechanical joint bells conforming to AWWA C 111. Glands shall be manufactured of ductile-iron conforming to ASTM A 536 with restraining mechanism of size and arrangement per manufacturer’s recommendations, of the following type:
  - (a) Ductile-iron wedges in combination with special, heat-treated set screws with or without twist-off nuts, torqued per manufacturer’s recommendations, or
  - (b) Hardened steel set screws with knurled and cupped points, with or without twist off nuts.
  - (c) “Megalug Series 1100” by EBAA Iron Sales, Inc., or “Uni-Flange Series 1400” by Ford Meter Box Co., are considered acceptable.
  - (d) Retainer glands shall meet working pressure ratings for pipe sizes shown in Table 809-1, except 20-inch and 24-inch diameter glands shall meet working pressure of 250 psi.

**(D) SLEEVE TYPE COUPLINGS.**

- (1) Couplings shall be designed, manufactured and installed in accordance with AWWA C219 except as modified below:
  - (a) The manufacturer shall provide an affidavit certifying compliance with the above standard.
  - (b) Couplings shall be designed for the specified operating and test pressures of the lines in which they are used.
  - (c) The manufacturer shall provide test data to verify that the couplings have been hydrostatically tested to the appropriate pressure.
  - (d) The Contractor shall verify the outside diameters of the pipes to be connected, and shall select the correct diameter sleeve-type couplings to ensure a proper fit without utilizing pipe stops.
- (2) The entire sleeve assembly shall be lined and coated with factory-applied coating system as follows:
  - (a) Fusion bonded epoxy per AWWA C 213, 12 mils minimum exterior coating thickness, 15 mils minimum interior coating thickness.
  - (b) Liquid epoxy per AWWA C210, 16 mils minimum, 25 mils maximum coating thickness.
  - (c) Other coating systems as approved by the Chief Engineer.
- (3) Bolts, nuts and harness tie rods shall be stainless or galvanized steel.
- (4) The Contractor may use mechanical joint sleeve at no additional cost to the District.

**(E) BOSSES – DUCTILE IRON PIPE (30-INCH AND LARGER DIAMETER WATER MAIN).**

- (1) A boss connection shall be utilized only where indicated on the Contract Drawings.
- (2) Bosses shall be located within a range of 1-1/2 feet from the bell end to 4 feet from the spigot end of the pipe.
- (3) Bosses shall be ductile-iron, 60-42-10 grade, or mild to medium grade carbon steel castings, as per ASTM A27.
- (4) Pipe sections selected to receive welded-on bossed outlets shall be ferritic grade ductile-iron per the following:
  - (a) Minimum Charpy impact test of 10 ft-lbs per ASTM E23 and AWWA C151.
  - (b) Minimum thickness shall be Special Thickness Class 52.
    1. Bosses shall be shop welded to ductile-iron pipe by the pipe manufacturer's certified welders, using nickel-iron electrodes such as Ni-Rod FC55 Cored Wire produced by Huntington Alloys, Huntington, West Virginia or approved equivalent. Field welding of bossed outlets is prohibited.

2. All completed welds shall have 100 percent of their surface inspected at pipe plant using the "Liquid Dye Penetrant Test Method" to insure integrity of welds.
  - (5) Bosses shall be mechanical joint welded outlets with sockets conforming to AWWA C110, unless otherwise shown on the contract documents. Interior and exterior surfaces of the outlet, including welds, shall be factory coated per 809.01(B).
  - (6) Bossed outlets shall be rated at the same pressure as the main pipe but not less than 250 psi with a safety factor of 2.0. Certified results of hydrostatic tests on each bossed outlet shall be submitted to the Chief Engineer prior to delivery.
  - (7) Minor damage to pipe cement lining and coating shall be repaired at pipe plant to meet AWWA C104.
  - (8) Bossed outlets manufactured by U.S. Pipe and Foundry Company or American Cast-Iron Company are conditionally acceptable. The Contractor shall submit statements from the manufacturer stating that these products meet the above requirements.
- (F) **2-INCH BLOWOFF VALVES.** Two-inch gate valve with pentagonal (5-sided) operating key nut shall be iron body, bronze mounted, epoxy coated inside and outside, 100% elastomeric-encapsulated symmetrical wedge, non-rising stem type with threaded ends (no flanges), 250 psi working pressure. Rotation of key nut to open shall be clockwise.

#### **809.02 CORRUGATED METAL CULVERT PIPE AND PIPE UNDERDRAIN**

Corrugated metal culvert pipe shall meet the requirements of AASHTO M 36, for the Type, Class, base metal and gage as specified in the Contract.

Corrugated metal pipe under drain shall meet the requirements of AASHTO M 36, Type III and Class as specified.

#### **809.03 CAST IRON PIPE**

Cast iron pipe and fittings shall meet requirements of ASTM A 74, Extra Heavy type.

#### **809.04 STEEL PIPE**

Steel pipe shall meet the requirements of ASTM A 53 for the Type and Grade specified.

#### **809.05 COPPER TUBE**

Seamless copper water tube shall meet requirements of ASTM B 88, Type K wall.

- (A) **SEAMLESS COPPER PIPE.** Seamless copper pipe shall meet the requirements of ANSI H26.1, ASTM B 42, FS WW-P-377d, or ASME SB-42.
- (B) **THREADLESS COPPER PIPE.** Threadless copper pipe shall meet the requirements of ANSI H26.2 or ASTM B 302.
- (C) **SEAMLESS COPPER TUBE.** Seamless copper tube shall meet the requirements of ANSI H23.3, ASTM B 75, or FS WW-T-797c.

- (D) **COPPER DRAINAGE TUBE, TYPE DWV.** Copper drainage tube, Type DWV shall meet the requirements of ANSI H23.6, ASTM B 306, or CS 229-60.
- (E) **SEAMLESS COPPER WATER TUBE.** Copper water tube, Types K, L, and M shall meet the requirements of ANSI H23.1, ASTM B 88, FS WW-T-799b-1970, or FS WW-T-799b-1963.

**810 VALVES AND HYDRANTS****810.01 VALVES**

**(A) STANDARD GATE VALVES.** Standard gate valves shall be per AWWA C 500, hand operated, iron-body, bronze-mounted, double-disc, for water works service under operating pressure of 150 psi.

AWWA C 500 is modified or supplemented as follows:

- (1) Valves shall be per New York Pattern, Metropolitan Gate Valves.
- (2) Size and type – Size shall be 12-inch and smaller. Type shall be iron-body, bronze-mounted, gate valves with double-disc gates having parallel seats and side wedges intended for ordinary water service. Each valve shall have 1/2-inch diameter pipe plug in the bonnet for testing. Valves shall be non-rising stem inside screw type except for exposed valves at the Wastewater Treatment Plan (WWTP) which shall be rising stem, outside screw and yoke type.
- (3) Intended Position of Valve – Valves shall be installed in the line in vertical position.
- (4) Type of Valve Ends – Valves shall be furnished with mechanical-joint ends complete with bolts, nuts, retainer glands and gaskets.
- (5) Orientation of Bolt Holes in Flanges of Mechanical joint – Manufacturer’s option.
- (6) Solid-Bronze Disc Gates – Not required.
- (7) Method of Fastening Gate Rings – Manufacturer’s option.
- (8) Type of Stem Seal – Double O-ring seals shall be furnished on all gate valves (stuffing boxes prohibited). O-ring seal plates shall be cast-iron; seal plate bolts and nuts shall be zinc coated per AASHTO M232.
- (9) Wrench Nuts – Special pentagonal operating nut shall be furnished for 6-inch and 8-inch diameter valves; drawing furnished by the District upon request. Square operating nut furnished for 12-inch valves.
- (10) Direction of Wrench Nut Rotation to Open – Right (clockwise) except for exposed valves at the WWTP which shall open left (counter-clockwise).
- (11) Steel Gears – Not permitted on gate valves.
- (12) Cast-Iron Gears – Not permitted on gate valves.
- (13) Type of Gear Case – Not permitted on gate valves.
- (14) Position Indicator – Not required.
- (15) Markings – Insofar as practicable, markings shall be readable by an observer looking down on the valve in line position.
- (16) Disc and Disc Seat Rings – Cast-iron discs in valves 6-inch through 12-inch diameter shall be accurately machined to receive bronze disc seat rings. The disc seat ring surfaces in contact with the iron disc and the dovetail projections shall be fully machined and the disc rings rolled, peened, or pressed into the machine

grooves on the iron disc and, when secured in place, a rough and finish cut shall be taken over the disc seat bearing surface.

(17) Minimum Diameter of Stem and Minimum Thickness of Body and Bonnet:

<b>Valve Diam. (Inches)</b>	<b>Diam. of Valve Stem at Base of Thread (Inches)</b>	<b>Min. Body/Bonnet Thickness (Inches)</b>
6	1.125	0.625
8	1.25	0.6875
12	1.50	0.750

(18) Valve Stems – Stem material shall be per ASTM B 584, alloy UNS No. 86700, or equivalent alloy with minimum 30,000 psi yield and approved for use in potable water service.

(19) Valve Wedges – Valve wedges for 6- and 8-inch valves shall be bronze; wedges for 10- and 12-inch valves shall be cast-iron.

(20) Valve Stem Thrust Collar Housings – Housings for valve stem thrust collars shall be carefully machined and fully bronze lined for all gate valves.

(21) Painting – Exterior surfaces of buried valves shall be coated with asphaltic varnish per AWWA C 500. Exposed valves shall be shop painted as directed.

**(B) RESILIENT-SEATED GATE VALVES.** Resilient-seated gate valves shall be per AWWA C 509, modified and supplementd as follows:

(1) Size and Type – Size shall be 12-inch and smaller. Valves shall be non-rising stem, inside screw type except for exposed valves at the WWTP which shall be rising stem, out side screw and yoke type.

(2) Waterway shall be smooth and shall have no depressions or cavities in seat area.

(3) Type of Valve Ends – Valves shall be furnished with mechanical-joint ends complete with bolts, nuts, retainer glands and gaskets.

(4) Type of Stem Seal – Double O-ring seals shall be furnished on all gate valves. O-ring seal plates shall be cast- iron; seal plate bolts and nuts shall be zinc coated per AASHTO M232.

(5) Valve Stems – Stem material shall be per ASTM B 584, alloy UNS No. 86700, or equivalent alloy with minimum 30,000 psi yield and approved for use in potable water service.

(6) Gate shall seat against seating surfaces arranged symmetrically about centerline of the valve stem.

(7) Wrench Nuts – Special pentagonal operating nuts shall be furnished for 6-inch and 8-inch diameter valves; drawing furnished by the District upon request. Square operating nut furnished for 12-inch valves.

(8) Direction of Wrench Nut Rotation to Open – Right (clockwise) except for exposed valves at the WWTP which shall open left (counter-clockwise). The number of turns

for 6-inch valves shall be 20; the number of turns for 8-inch valves shall be 26; the number of turns for 12-inch valves shall be 38.

- (9) If bonnet is two-piece, parts shall be through-bolted; tapped holes with stud bolts prohibited.
  - (10) Valve body and bonnet shall be coated on all exterior and interior surfaces with a fusion-bonded epoxy per AWWA C 550. Painted surfaces and spray applied epoxy coatings are not acceptable.
  - (11) The manufacturer's name, pressure rating, year of manufacture and size shall be cast on valve body.
  - (12) Each valve shall be tested to 400 psi hydrostatic pressure.
- (C) **BUTTERFLY VALVES.** Butterfly valves shall be per AWWA C 504 except as otherwise supplemented herein. Butterfly valves of the "wafer type" are not acceptable.

The manufacturer shall be regularly engaged in the design, manufacture, and maintenance of butterfly valves. The manufacturer must furnish satisfactory evidence of adequate facilities for furnishing repair parts and for maintenance of valves furnished.

AWWAC 504 is modified or supplemented as follows:

- (1) Size – Size shall be 16-inch and larger as specified.
- (2) Valve Bodies – Butterfly valves 16-inches through 24-inches in diameter shall be furnished with mechanical joint ends complete with bolts, nuts, retainer glands and gaskets.  
Butterfly valves 30-inches diameter and larger shall be furnished with flanged joint ends with accompanying flanges and plain-end pieces assembled to the valve's flanged ends with bolts, nuts and gaskets. Each flanged and plain-end piece shall have an overall laying length of not less than 12 inches nor more than 18 inches.
- (3) Class – All parts shall be designed for Class 150B for use on water mains carrying filtered water with an approximate average pH of 7.5.
- (4) Valve Shafts – Valve shafts shall be fabricated of either Type 316 or Type 304 wrought stainless steel and shall be either a one-piece unit extending completely through the valve disc or be of the "stub shaft" type.
- (5) Valve Discs – Discs shall be cast-iron per ASTM A 48, Class 40 or ductile-iron per ASTM A 536, Grade 65-45-12.
- (6) Valve Seats – Seats shall be mechanically retained either in the valve disc or in the body:
  - (a) 360 degree rubber seat edge on disc, retained by corrosion- resistant disc retainer ring and Type 304 stainless cap screws. Mating seat in valve body shall consist of a Type 304 stainless steel separate ring, set integral with body.
  - (b) 360 degree rubber seat in valve body, retained by corrosion- resistant disc retainer ring segments and Type 304 stainless cap screws. Mating seat on valve disc shall consist of either Type 316 stainless steel or monel disc edge on the case or ductile-iron disc.

- (7) Valve Bearings – A jacking or adjusting device to provide axial adjustment of the shaft and attached disc shall be provided for valves larger than 24-inch diameter. The jacking or adjusting assembly shall be protected from break-off or thread damage by recessing, cover plate, or other approved method. As an alternate to the aforementioned, a factory adjusted and set thrust bearing, may be provided to carefully center the disc in the valve body. The thrust bearing shall be of adequate strength to carry all axial loads.
- (8) Shaft Seals – Shaft seals shall be designed for use of standard O-ring seals only. Seals of the type utilizing a stuffing box and pull-down packing gland are prohibited.
- (9) Type of Installation – Buried, except for WWTP which may be buried or exposed.
- (10) Type of Operator – Manual unless otherwise specified.
- (11) Direction of Operating Stem Rotation to Open Valve – Right (clockwise) except for exposed valves at the WWTP which shall open left (counter-clockwise).
- (12) Valve Operators – Unless otherwise approved or shown on the drawings, a manual operator shall be furnished, assembled to each valve. The operating stem shall be provided with a 2-inch square nut. Manual operators shall be totally enclosed worm gear or link lever design.
- Operators on valves 24-inch and smaller diameter may be of the traveling nut design per AWWA C 504, but in either case, the valve operator shall require a minimum of 35 turns from closed to open position.
- Operators shall have adjustable stop limiting devices, for open and closed position, that must withstand an input torque of 300 foot-pounds on the square key nut without damaging the valve or operator. Stop limiting devices shall be factory set at the time of valve testing.
- (13) Valve Position Indicators shall be totally enclosed with no exposed moving parts. A highly visible and corrosion resistant valve position indicator shall be provided on all valves. The valve position indicator shall be such that the position of the valve (open-closed) may be determined from above at the operating level. The valve-operating stem shall be in the vertical position at all times. Indicators shall be Beacon type or approved equivalent product manufactured by Westlock Controls Corporation, 280 Midland Avenue, Saddle Brook, New Jersey.
- (14) Markings – All identifying or data plates or markings bearing serial numbers, ratings, and other essential information shall be placed on the valve body or operator so they are readable from above.
- (15) Painting – Exterior surfaces of buried valves shall be coated with asphaltic varnish per AWWA C 504. Exposed valves shall be shop painted as directed.

### 810.02 FIRE HYDRANTS

Fire hydrants shall be compression type, hand operated for fire protection service under operating pressure of 200 psig manufactured per AWWA C 502. All fire hydrants furnished shall be tested to 300 psig operating pressure.

The manufacturer shall be regularly engaged in the design, manufacture and maintenance of fire hydrants. The manufacturer must furnish satisfactory evidence of adequate facilities for furnishing repair parts for hydrants furnished.

Hydrant Models – Mueller Centurion 200-Model No. A-423, (made by Mueller Company, Decatur, Illinois), Kennedy Guardian-Model No. K-81-A (made by Kennedy Valve, Elmira, New York), U.S. Pipe Metropolitan-Model No. 250 (made by U.S. Pipe and Foundry Company, Birmingham, Alabama), American-Darling – Model No. B-84-B, (made by American Flow Control, Birmingham, Alabama), Clow Medallion – Model No. 2545, (made by Clow Valve Company, Oskaloosa, Iowa) or approved equal.

Alternate fire hydrants shall be submitted in advance with the Contractor's Preliminary Construction Scheduling, 108.03, for approval.

AWWA C 502 is modified or supplemented as follows:

- (1) When required, the manufacturer shall furnish catalog and maintenance data.
- (2) Certified drawings showing the principal dimensions, construction details, and materials shall be submitted for approval per "Plans and Working Drawings", 105.02.
- (3) Affidavit of compliance required.
- (4) Size – 5-1/4 inch minimum, nominal I.D. main valve opening.
- (5) Bury Length – 4-1/2 feet of cover.
- (6) Barrel Sections – Hydrants shall be "traffic" type fire hydrants with frangible cross section near the ground line designed to break on vehicle impact.
- (7) Hydrant Top – Hydrants shall be permanently lubricated and require one man maintenance, no special tools.
- (8) Outlet Nozzles – Two 2-1/2 inch nominal I.D. hose nozzles; one 4-inch nominal I.D. pumper connection.  
 Threads for 2-1/2 inch nozzles per National Fire Standard Hose Coupling Screw Threads; threads for 4-inch pumper connection:  
 major diameter: 5-3/32 inch  
 thread form: V  
 number threads/inch: four
- (9) Operating Stem and Mechanism – Operating and outlet nozzle cap nuts shall be pentagonal in shape. The pentagon shall measure 1-51/64 inch from point to flat at the base of the nut and 1-47/64 inch at the top. Height of the nut shall be 1 inch. Direction of operating nut rotation to open: Left (counterclockwise). Drawings furnished by the District upon request.
- (10) O-Ring Seals – O-ring seals shall be used in lieu of stuffing box.
- (11) Gaskets – Material shall be rubber composition; asbestos prohibited.
- (12) Hydrant Inlet – Boot side inlet shall be 6-inch diameter with retainer gland mechanical joint per 809.01(C).

(13) Cap Chains – hose cap chains and steamer cap chains are required with all hydrants.

Chain links (zinc plated steel) shall be fabricated not less than 1/8 inch in diameter and with S hook device (zinc plated) attached.

(14) Painting – Above grade line, outside of hydrant shall be painted with two coats of zinc chromate primer and two finish coats of No. 209 medium green enamel manufactured by Purity Paint Products Corp., Brooklyn, New York; or approved equivalent product.

Gravel for Dry Well: Washed gravel.

Filter Fabric:

- (1) Woven filter fabric shall be composed of polypropylene monofilament yarns woven into sheets of approximately sixteen-(16) mil thickness. The tensile strength of the fabric shall be per ASTM D1682. The weave of the fabric shall be dense and tight so the openings are barely visible.
- (2) The test results shall indicate the filter fabric can effectively retain particles coarser per opening of U.S. 140-sieve mesh for all conditions.
- (3) Tests shall also demonstrate that the filter permeability is between 3.3 and 3.8 x 100 centimeters per second.
- (4) Filter fabric shall be manufactured by Mirafi Company, P.O. Box 240967, Charlotte N.C. or approved equal.

**811 PAINTS, COATINGS AND PRESERVATIVES****811.01 GENERAL**

- (A) **Certification** – All paints to be furnished shall be certified by the manufacturer to be in conformance with this specification prior to being shipped to the project site.
- (B) **Factory Testing Requirements** – Unless otherwise specified, paint shall be factory tested in conformance with Federal Test Method Standard 141. Tests shall be performed at 75° F and 50% relative humidity unless otherwise specified.

- (C) **Material and Packaging Requirements** – Only one formulation per color will be permitted per project. All paint shall be satisfactory for brushing, rolling, or spraying.

All paints within a system shall be from the same manufacturer and shall be tinted at the point of manufacture to differentiate between coats, existing coats, and bare metal. Paint shall be shipped in the original containers and all containers shall bear the identification of the paint, consisting of the manufacturer's name, the name or title of material, volume of contents, manufacturer's paint identification number, the date of manufacture, color name and number, handling instructions, precautions, and the batch number. A materials product safety data sheet shall also be provided.

- (D) **Approved Paint Manufacturers** – the District shall consider only those manufacturers from either the states of Maryland or Virginia list of Approved Paint Manufacturers, subject to acceptance of the manufacturer's submitted Quality Control Plan.
- (E) **Quality Control Plan** – The Quality Control Plan shall define the manufacturer's process to ensure that the quality of the products during and upon completion of the manufacturing process. As a minimum, the Quality Control Plan shall list the following information:
- (1) Name of quality control tests and test procedures used.
  - (2) Detailed description of the test procedures if not a standard test.
  - (3) Frequency of quality control tests.
  - (4) Maintenance of quality control records and length of time that they will be maintained.
- (F) **Acceptance** – The paint manufacturer shall furnish certified test results for each lot and color of paint as specified. Certified test results for each lot shall list the actual test results for the specified properties. The certification shall be approved by the Chief Engineer prior to shipment, and a copy shall accompany each shipment.
- (G) **Original Infrared Spectrogram** – The manufacturer shall submit an original analysis of vehicle solids by infrared spectroscopy performed as specified in ASTM D 2621 as follows:
- (1) For zinc primers coatings, infrared spectrum (2.5 to 15  $\mu\text{m}$ ) of each vehicle component.

- (2) For two component coatings, infrared spectrum ( 2.5 to 15  $\mu\text{m}$ ) of each single component and each mixed component when applicable, in appropriate mixing ratios.

- (H) **Certification Verification Tolerances** – The Chief Engineer shall be permitted to visit the manufacturer’s facilities at random intervals to obtain his own test samples. A comparison will be made between the manufacturer’s certified test results and the District’s test results on the same batch. Any materials test results not within the established tolerances shall be cause for rejection of the material by the Chief Engineer. The tolerances between these results shall conform to the following:

TEST	TOLERANCE	TEST METHOD
Total Solids by mass, %	$\pm 2$	ASTM D 2369
Pigment Content by mass, %	$\pm 2$	ASTM D 2698 or ASTM D4451
Vehicle Solids by mass, %	$\pm 2$	ASTM D 2369
Viscosity, KU	$\pm 10$	ASTM D 562
Unit Weight, lbs/gal	$\pm 0.5$	ASTM D 1475
Volatile Organic Compound (VOC)	Maximum limits of VOC shall conform to the current regulations governing the point of application, whether in the District or in other jurisdictions; however, any one type of paint specified for both shop-field (District) application shall be subject to the more restrictive criteria of the two jurisdictions.	

- (I) **Field Sampling and Testing by the Chief Engineer** – After delivery, the paint shall at all times be subject to field sampling and testing by the Chief Engineer. The unit weight (minimum net weight per gallon) and color shall constitute minimum field acceptance requirements. The Chief Engineer reserves the right to take a reasonable number and volume of samples from the supplied stockpile in the field as deemed necessary to conduct independent verification testing.

All rejected paint shall be so marked and immediately removed from the work area to the satisfaction of the Chief Engineer.

### 811.02 RAW MATERIALS

- (A) Raw materials used in paint, coatings, and preservative products shall meet the requirements as indicated in Table 811.02 below. Inclusion in this table does not necessarily indicate the product’s acceptability for use in the District. Paint shall not be formulated with compounds of heavy metals listed in 40CFR 261.24 Table 1, except that barium sulfate is allowed. The manufacturer shall refer to DCMR Title 20 –Environment, for further restrictions on use, if any, of the materials listed below.

TABLE 811.02

Raw Material	Specification
Acrylic Resin .....	100% straight acrylic polymer dispersed in water
Alkyd Resin .....	FS TT-R-266, Type I, Class A or B
Aluminum Pigment, Paste .....	FS TT-T-291, Type II, Class 2 or ASTM D 962
Aluminum Stearate.....	Military MIL-A-15206A
Basic Zinc Chromate Butyral.....	MS MIL-C-153-28A
Carbon Black.....	FS TT-P-343, Form I, Class A, or ASTM D 561, Type I
Chromium Oxide, Green .....	FS TT-P-381, Color 4D, or ASTM D 263
Lampblack (paste in oil).....	FS TT-P-381, Color 1D, or ASTM D 209
Linseed Oil Heat-Polymerized .....	FS TT-L-201, Type II, Viscosity 2-2
Linseed Oil, Raw.....	ASTM D 234
Linseed Oil, Boiled .....	ASTM D 260, Type I
Magnesium Silicate.....	ASTM D 605
Methyl Ethyl Ketone.....	ASTM D 740
Mica (325 mesh) .....	ASTM D 607
Micaceous Iron Oxide .....	Processed specular hematite ore with lamellar structure conforming to ASTM D 5532 Type I
Mineral Spirits.....	ASTM D 235
Organo Montemorillonite.....	An organic ammonium compound of montemorillonite. It shall be a fine, creamy whpowder, with high gelling efficiency in a wide range of organic liquids, with water content of less than 30% and fineness of less than 5 % retained on the No. 200 sieve.
Phosphate Pretreatment.....	MS MIL-C-10578 or ASTM F 1137
Raw Sienna .....	ASTM D 765
Soybean Oil, Refined .....	ASTM D 1462
Soybean Oil, De-gummed .....	ASTM D 124
Spar Varnish.....	FS TT-V-121
Tallow .....	FS C-T-91
Titanium Dioxide .....	ASTM D 476, Type I or III, Rutile
Thinner, Mineral Spirits .....	FS TT-T-291, Type II, Grade A, or ASTM D 235
Tuolene .....	ASTM D 841
Tricresyl-phosphate.....	ASTM D 363
Turpentine, Gum Spirits and Wood.....	FS TT-T-801, Type I or II. or ASTM D 235
Varnish, Spar, Water Resisting .....	FS TT-V-121
Volatile Thinners.....	ASTM D 235
Yellow Iron Oxide.....	ASTM D 768
Zinc Dust.....	ASTM D 520, Type II
Zinc Oxide .....	ASTM D 792-ethoxyethanol-ASTM D 3728

**811.03 PRIME COAT**

Included in this subsection are the requirements of shop and field applied primer coatings used for spot painting on properly prepared new and existing steel.

**(A) GENERAL REQUIREMENTS**

1. On areas to receive two coats of primer paint, the first coat shall be darkened with 1/4 ounce of lampblack paste per gallon of paint to provide a contrast between shades of the two coats, directed by the Chief Engineer.
2. All shop-applied primer coatings for steel shall conform to AASHTO M 300.  
Class B slip coefficient and creep testing criteria for use on faying surfaces of A-325 or A-490 bolted connections unless otherwise approved by the Chief Engineer.

**(B) INORGANIC ZINC RICH PRIMER.** Inorganic Zinc Rich Primer shall conform to AASHTO M 300, Type I or IA. Self-curing inorganic zinc-rich primers shall be solvent base vehicle type.**1. Material Requirements**

- a) The pigment used in the formulation shall be zinc dust and shall conform to the requirements of ASTM D 520, Type II. Small amounts of color and extender pigments may be used provided the quantitative requirements of the complete paints are met. The color of the inorganic zinc primer shall be such that a definite contrast is readily apparent between it and the color of blasted steel.
- b) Vehicle shall be a solvent solution with silicates, curing aids, tinting colors, suspension and pot life control agents as selected by the manufacturer.
- c) The pot life of the mixed paint shall be a minimum of 8 hours at 77° F and 50% humidity. The vehicle of the paint shall show no thickening, curdling, gelling, gassing, or hard caking after being stored unmixed for 9 months from date of manufacture in a tightly covered unopened container at a temperature of 50° to 90° F. Storage life shall be in accordance with ASTM D 1849.

**2. Drying Time**

Set to touch time of mixed paint shall be determined in accordance with ASTM D 1640 and shall not exceed 30 minutes at 77° F .

Cure hard to recoat time of mixed paint shall be determined by the methylethyl ketone (MEK) rub test. Using a wadded piece of cheesecloth saturated with methylethyl ketone, rub with a firm pressure over a one inch long section of primer 50 times. Examination of the surface of the primer shall show only burnishing, polishing or trace removal of loose particles when the primer has been cured for 24 hours at 80° F and 90 % relative humidity.

**(C) ALUMINUM EPOXY MASTIC .** Aluminum epoxy mastic primer shall have one component that is the condensation product of the reaction of epichlorohydrin with bisphenol A. Drying time shall be 8 hours maximum to touch, 24 hours minimum to 30 days maximum for recoat, and 48 hours maximum to hard. Minimum pot life shall be three hours. Solids shall be 90 % minimum by weight and 80% to 90% by volume.

Viscosity shall be 95 to 140 KU and flexibility shall pass a 180° bend around a ¾ inch mandrel when tested in conformance with ASTM D 522. The material shall resist sagging when tested in conformance with ASTM D 4400 with no sagging at the manufacturer's recommended wet film thickness. The mixed paint shall weigh 13.0 ±0.5 lb/gal.

- (D) **ORGANIC ZINC RICH PRIMER** . Organic zinc rich primer shall conform to SSPC-Paint 20, Type II.
- (E) **ZINC RICH MOISTURE CURED URETHANE**. Zinc rich moisture cured urethane primer shall be one-component having a minimum zinc pigment content in the dry film of 80 %. Minimum solids shall be 80% by weight and 62% by volume. The viscosity shall be 95 to 105 KU. The primer shall be capable of being applied at 50% greater film build than required without runs or sags in conformance with ASTM D 4400.

The interval of application of next coat shall be 8 hours minimum and 30 days maximum. The coating shall also conform to the Moisture Cured Urethane Additional Performance Criteria Table except that the maximum loss for Abrasion Resistance shall be 82.0 mg, and Salt Spray after 1000 hours shall be 1/32 in. maximum.

- (F) **MICACEOUS IRON OXIDE AND ALUMINUM FILLED MOISTURE CURED URETHANE** . Micaceous iron oxide and aluminum filled moisture cured urethane shall have a minimum solids content of 75% by weight and 60 % by volume. The viscosity shall be 95 to 100 KU. The coating shall conform to the Moisture Cured Urethane Additional Performance Criteria Table.
- (G) **PENETRATING SEALER**. Penetrating sealer shall have a viscosity of 75 to 101 KU and be able to penetrate and seal existing coatings and substrate. It shall be suitable for application over marginally prepared steel and most generic types of aged coatings. The sealer shall conform to one of the following:
1. Epoxy penetrating sealer shall be cross-linked amido-amine epoxy primer/sealer having two components mixed in conformance with the manufacturer's recommendation. It shall contain a minimum of 95% solids by weight.
  2. Moisture cured urethane micaceous iron oxide filled penetrating primer/sealer shall be one component having a minimum of 75% solids by weight. It shall also conform to the Moisture Cured Urethane Additional Performance Criteria Table.
- (H) **ZINC DUST-ZINC OXIDE PRIMER PAINT**. Zinc dust-zinc oxide primer paint shall conform to the requirements of the Federal Specification TT-P-641G, Type I (linseed oil-thinner vehicle). Pigment content shall be 78 to 81% of total weight. Minimum net weight of the finished paint shall be 23 pounds per gallon. This paint shall be used for priming galvanized metal prior to field painting with finish coats.
- (I) **PETROLATUM PRIMER**. Rust-inhibitive petrolatum primer shall conform to the requirements of the U.S. Maritime Administration Specification 52-MA-602, Type B Medium. This primer shall be used for coating field metal to metal contact surfaces, field weld areas, or other metal surfaces where a temporary rust-inhibitive coating is required. This primer may be removed by wiping with thinner (mineral spirits) conforming to requirements of 811.02.

- (J) **WOOD PRIMER-SEALER.** Wood primer-sealer shall conform to requirements of the Federal Specification TT-P-25E. This primer-sealer shall be used for priming new wood surfaces and weathered, previously painted wood surfaces prior to field painting with finish coats.
- (K) **ZINC-CHROMATE, LOW-MOISTURE SENSITIVITY.** Factory-mixed zinc-chromate low moisture sensitivity primer shall conform to the requirements of FS TT-P-1757, Composition L. This paint shall be used to coat surfaces of aluminum parts that will be embedded in concrete or masonry.

#### 811.04 INTERMEDIATE (MID) COAT.

The intermediate (mid) coat, if specified, shall be from the same paint manufacturer as the prime coat and shall be compatible with the primer and the topcoat.

- (A) **EPOXY POLYAMIDE INTERMEDIATE COAT.** Epoxy polyamide intermediate coat shall have one component that is the condensation product of epichlorohydrin with bisphenol A. The epoxy polyamide shall have a 3.0 minimum fineness of grind (Hegman Units), and maximum solids content of 75% by weight and 62% by volume. Maximum dry time to touch and recoat shall be 6 and 15 hours, respectively.
- (B) **MICACEOUS IRON OXIDE MOISTURE CURED URETHANE INTERMEDIATE COAT.** Micaceous iron oxide moisture cured urethane intermediate coat shall have one component with minimum solids content of 80% by weight and 60% by volume. The viscosity shall be 90 to 100 KU. The interval for application of next coat shall be 8 hours minimum and 30 days maximum. The coating shall also conform to the Moisture Cured Urethane Additional Performance Criteria Table. The micaceous iron oxide content shall be a minimum of 3.0 lb/gal.

#### 811.05 TOPCOAT

- (A) **ALUMINUM TOPCOAT.** Aluminum paint used as a topcoat shall be a two-component aluminum leafing paint composed of 1-1/2 pounds of aluminum pigment paste for each gallon of aluminum mixing varnish.

This aluminum mixing varnish shall be a long oil varnish and shall contain not less than 50 percent, by weight, of non volatile oil and gums. The varnish shall be free from sulphur, sulphur compounds and rosin. The acid number of the varnish shall be not more than 10, based on the nonvolatile content.

The varnish shall pass a 100 percent Kauri reduction test.

The viscosity of the varnish shall be from A to D inclusive, as determined with Gardner Bubble Viscometer, Varnish Series.

The varnish, when mixed with paste, shall produce a paint showing satisfactory leafing and spreading properties, and shall not run nor sag when applied to a smooth vertical surface.

The paint shall set to touch in not less than 2 hours nor more than 6 hours, and shall dry hard and tough in not more than 24 hours.

The aluminum paste and varnish shall be furnished in separate containers unless otherwise permitted by the Chief Engineer. The container for the varnish shall be of such size as will permit the mixing of the paste and varnish in the proper proportion without overflow.

Leafing paint shall be mixed immediately prior to application, in the presence of the Chief Engineer and shall be used within 24 hours after mixing.

Leafing and non-leafing paint shall not be mixed together, and paints so blended will be rejected.

The paste shall conform to Federal Specification TT-P-320, Type II, Class 2, except the paste shall be non-leafing.

- (B) **ACRYLIC FINISH COAT.** Acrylic finish coat shall be a single component 100% acrylic system and shall have minimum solids content of 48% by weight and 36% by volume. Maximum dry time to touch and recoat shall be 2 hours and 8 hours respectively.
- (C) **ALIPHATIC URETHANE FINISH COAT.** Aliphatic urethane finish coat shall have minimum solids content of 70% by weight and 47% by volume. Drying time to touch and hard shall be the minimum recommended by the paint manufacturer.
- (D) **MOISTURE CURED ALIPHATIC URETHANE FINISH COAT.** Moisture cured aliphatic urethane finish coat shall be a single component with a maximum free monomer content of 0.7 %. Minimum solids content shall be 75% by weight and 60% by volume, and the viscosity shall be 70 to 80 KU. The interval for application of next coat shall be 8 hours minimum and 30 days maximum. The coating shall also conform to the Moisture Cured Urethanes Additional Performance Criteria Table.
- (E) **OTHER TOPCOATS.** The following paints shall be used only in maintenance situations to overcoat existing paints of the same type. Colors shall match existing colors.
  - 1) **LIGHT-GRAY PAINT.** Factory mixed light-gray alkyd-gloss enamel paint shall conform to the requirements of FS TT-E-489G, Type I, Class A for brush application, or Class B for spray application (if gloss is not desired, paint shall conform to the requirements of FS TT-P-105), and shall be tinted with lamp black paste to match Paint Chip No. 26408 of FS-TT-C No. 595, "Colors." On areas to receive two coats of this paint, the first coat shall be darkened with additional lampblack paste in sufficient amount to provide a contrast between shades of the two coats, subject to approval by the Chief Engineer.
  - 2) **WHITE PAINT.** Factory mixed white alkyd-gloss enamel paint shall conform to the requirements of FS TT-E-489G, Type I, Class A for brush application, or Class B for spray application (if gloss is not desired, paint shall conform to the requirements of FS TT-P-105). On areas to receive two coats of this paint, the first coat shall be darkened with lampblack paste with the minimum amount of lampblack added.
  - 3) **GRAY CHANNEL PAINT (PEPCO).** Paint to coat light standard installations after erection; all exposed shop painted surfaces shall be field painted with one coat of alkyd gloss enamel gray channel paint meeting the requirements of FS-TT-E-489G and matching the gray paint color used by PEPCO.

- 4) **ASPHALT VARNISH PAINT.** Factory-mixed asphalt varnish paint shall conform to requirements of FS TT- V-51, for “Varnish, Asphalt”. This paint shall be used to thoroughly coat surfaces of aluminum parts that will come in contact with concrete or masonry surfaces, but excluding aluminum parts embedded in concrete or masonry.

#### 811.06 SOLVENTS

Solvents used for solvent cleaning of metal surfaces shall include kerosene, varsol, naphtha, and mineral spirits. Substances not removable by these solvents shall be removed by methods and chemicals presented in Chapter 2.9 of Steel Structures Painting Council (SSPC) “Good Painting Practice,” Volume I.

Solvents shall be approved by the Chief Engineer before use.

#### 811.07 GALVANIZING

Galvanizing shall refer to the coating of steel or iron parts with metallic zinc by the hot dip or mechanical process.

All metal parts to be galvanized shall be thoroughly cleaned before application of zinc, and for steel and iron castings, this cleaning shall include sandblasting.

Galvanizing of iron and steel hardware shall conform to the requirements of AASHTO M232 for the hot-dip process or ASTM B695, Class 50, for the mechanical process.

Galvanizing of rolled, pressed, and forged steel shapes, plates, bars and strips shall conform to the requirements of AASHTO M-111.

#### 811.08 WOOD PRESERVATIVES

- (A) **PRESSURE TREATMENT FOR PARK TYPE WOODEN GUARDRAIL.** Pressure treatment shall be with pentachlorophenol petroleum solution in accordance with AWWA C14, with a minimum net retention of 0.4 pound per cubic foot. The pentachlorophenol solution shall have a minimum of 5 percent pentachlorophenol, meeting the requirements of AASHTO M 133 (AWPA-P8), in an oil-base vehicle, meeting the requirements of AASHTO M 133, and as nearly colorless as obtainable.
- (B) **TIMBER PILES.** Timber piles shall conform to AASHTO M 133 and AWWA C3 except that creosote shall not be used.
- (C) **WOOD SIGN POSTS.** Preservative shall conform to AASHTO M 133 and pressure treatment shall conform to the requirements of AWWA C2.

#### 811.09 PREQUALIFIED COATING SYSTEMS

- (A) **PREQUALIFIED COATING SYSTEMS.** Pre-qualified coating systems for structural steel are listed in Table 811.09.

**TABLE 811.09 PREQUALIFIED COATING SYSTEMS FOR STRUCTURAL STEEL**

	<b>New or Existing Steel</b>	<b>Existing Steel</b>
	<b>Shop Painting</b>	<b>Field Painting</b>
<b>Prime Coat</b>	Inorganic Zinc-Rich Primer	Organic Zinc-rich Primer
<b>Intermediate Coat</b>	Epoxy Polyamide	Epoxy Polyamide
<b>Finish Coat</b>	Aliphatic Urethane Topcoat	Aliphatic Urethane Topcoat

Note: Multiple applications of an individual coat may be necessary to achieve the total DFT required by the contract.

## **812 REINFORCING STEEL AND WIRE ROPE**

### **812.01 WELDED WIRE FABRIC**

Steel welded wire fabric reinforcement shall consist of longitudinal main members with transverse members at right angles thereto. Intersecting members shall be electrically welded in such manner as to develop the full tensile strength across the welds. The steel wire fabric shall meet the requirements of AASHTO M 55, and shall conform to the weights and spacings as shown on the plans.

### **812.02 DEFORMED REINFORCING STEEL**

Reinforcing steel shall meet the requirements of AASHTO M 31, Grade 60, as specified, except that reinforcing steel for sewer-water structures shall be Grade 60.

Reinforcement shall be newly rolled in an approved mill and accurately fabricated to the dimensions shown in the Contract Documents. Rail-steel bars are prohibited.

Hooks and stirrups shall be bent using dimensions and diameters defined by ACI Standard Hooks in the Manual of Standard Practice of CRSI.

All reinforcing steel radii bends regardless of size shall be dimensioned and payment will be made as correctly dimensioned.

### **812.03 EPOXY COATED REINFORCEMENT BARS**

Epoxy coated reinforcement bars shall meet the requirements of AASHTO M 284 including the prequalification requirements of AASHTO M 284, Annex A1. For acceptance purposes at least 90 percent of all recorded film thickness measurements shall be as per Section. 8.1 of AASHTO M 284.

**813 FENCE AND GUARDRAIL****813.01 BARBED WIRE**

Barbed wire shall conform to the requirements of AASHTO M 280 for the coating class specified.

**813.02 WOVEN WIRE FENCE FABRIC**

Woven wire shall conform to the requirements of AASHTO M 279 for the coating class specified.

**813.03 CHAIN LINK FENCE**

(A) **GENERAL.** When the type of chain link fence is not specified, all chain link fence materials including chain link fabric, posts, rails, ties, bands, bars, rods, hardware and other fittings shall meet the requirements of AASHTO M 181. Type I shall be used unless otherwise specified in the contract documents.

(1) **Chain Link Fence Fabric.** Chain Link Fence Fabric shall be a No. 9 gauge fence fabric, woven in a 2 inch by 2 inch diamond mesh and shall conform to the requirements of AASHTO M 181 unless otherwise noted in the contract documents. Type I fabric shall conform to Class D coating. Polyvinyl Chloride (PVC) coated steel fabric shall conform to F 668, Class 2B, thermally fused. Polyvinyl chloride (PVC) color shall be warm gray or black as specified in the contract documents.

(2) **Tie Wires, Wire Clips, Tension Wires and Tension Wire Clips.** These items shall conform to AASHTO M 181. The galvanized coating shall have a minimum weight of 1.2 oz./sq. ft. These items, when used with aluminum coated steel fabric, shall be coated with aluminum at a minimum weight of 0.40 oz./sq. ft. The tension wire used with polyvinyl chloride (PVC) coated steel fabric shall have the same coating thickness and color requirements as the fence.

(3) **Posts, Post Braces, Tension Bars, Truss Rods, Fittings and Hardware.** These items shall conform to AASHTO M 181. When these items are specified to be PVC coated, they shall be thermally fused and bonded. The PVC thickness shall be 10 to 15 mil except that the bolts, nuts and washers shall be metallic coated steel.

(4) **Gates.** Gate materials shall conform to AASHTO M 181. The fabric used for gates shall be identical to the fence fabric. The gate frame and other hardware shall conform to 813.03(A)(2) and 813.03(A)(3). When the gate frame is PVC coated, movable fittings, such as hinges and latches, shall be field coated with a PVC coating specifically prepared for this purpose.

(B) **VINYL CLAD CHAIN LINK FENCE WITH REDWOOD SLATS.** The materials for this type of fence shall be chain link fence meeting 813.03(A).

(C) **SAFETY FENCE SHIELDING.** Safety fence shielding shall be chain link fence meeting 813.03(A).

Plates shall meet the requirements of ASTM A 36.

Anchor bolts shall meet the requirements of ASTM A 307, Grade A.

**813.04 METAL BEAM RAIL**

The rail elements shall be corrugated sheet steel beams conforming to the requirements of AASHTO M 180 Class A, Type 1. Galvanizing shall be in accordance with AASHTO M 111.

**813.05 TIMBER RAIL**

The timber rail, including offset blocks, shall be cut from the specified grade of dry, well seasoned and dressed timber block of the species specified, which shall meet the applicable requirements of AASHTO M 168.

Where preservative treatment is specified this shall conform to the requirements for "Preservative Treatments for Timber" of the AASHTO Standard Specifications for Highway Bridges. Timber preservatives shall conform to the requirements of AASHTO M 133.

**813.06 FENCE POSTS**

(A) **WOOD POSTS.** Wood posts shall conform to the details and dimensions indicated on the plans. All wood posts shall be of sound, seasoned wood, peeled and with ends cut square or as indicated. The posts shall be straight and all knots trimmed flush with the surface. Where treated posts are specified, the kind and type of treatment shall conform to that indicated on the plans. When red cedar posts or bracing is furnished, the requirements for peeling may be omitted.

All dimension timber and lumber required for fences or gates shall be sound, straight, and free from knots, splits, and shakes. It shall be of the species and grades indicated on the plans and shall be dressed and finished on all four sides.

(B) **CONCRETE POSTS.** Concrete posts shall be made of concrete, Class A, and shall contain steel reinforcement as shown on the plans.

(C) **STEEL POSTS.** Steel posts shall be galvanized in accordance with AASHTO M 111 except that tubular steel posts shall be galvanized in accordance with ASTM A 53. Fittings, hardware, and other appurtenances not specifically covered by the plans and specifications shall be standard commercial grade, and in accordance with current standard practice.

**813.07 GUARDRAIL POSTS**

Guardrail posts shall conform to the requirements of AASHTO M 183. Galvanizing shall be as per ASTM M 111. Nuts, bolts and washers for steel guardrail shall conform to the requirements of AASHTO M 180.

**813.08 BOX BEAM RAIL**

Steel beam rail elements shall conform to the requirements of ASTM A 500 Grade B or ASTM A 501 and shall be galvanized after fabrication in accordance with AASHTO M 111, except when corrosion resistant steel rail elements are specified. In which case rail elements shall be made of steel meeting the dimensional and mechanical requirements of ASTM A 500 or ASTM A 501 and having an atmospheric corrosion resistance approximately two times that of carbon structural steel with copper and shall not be painted or galvanized.

## 814 CONCRETE CURING MATERIALS AND ADMIXTURES

### 814.01 BURLAP

Burlap shall meet the requirements of AASHTO M 182, Class 3.

### 814.02 SHEET MATERIALS

- (A) **POLYETHYLENE SHEETING.** Polyethylene sheeting for curing portland cement concrete shall meet the requirements of AASHTO M 171 and shall be opaque white.
- (B) **WATERPROOF PAPER.** Waterproof paper for curing portland cement concrete shall meet the requirements of AASHTO M 171.
- (C) **WHITE BURLAP-POLYETHYLENE SHEET.** White burlap-polyethylene sheet for curing portland cement concrete shall meet the requirements of AASHTO M 171.
- (D) **INSULATION BLANKET.** Insulation blanket used for curing portland cement concrete shall be impervious to water, of uniform thickness and composition, and of a size acceptable to the Chief Engineer for its intended use and shall conform to the requirements of ASTM C553. A sample of material representative of that proposed for use shall be submitted by the Contractor and approved prior to use.

### 814.03 LIQUID MEMBRANE CURING COMPOUNDS

- (A) Membrane curing compound shall meet the requirements of AASHTO M 148, Type 1D with fugitive dye, Class B.
- (B) For walls, membrane cure shall meet the requirements of AASHTO M 148, Type 1 Class B.

### 814.04 AIR ENTRAINING ADMIXTURES

Materials to be incorporated in PCC to entrain air shall meet the requirements of AASHTO M 154.

### 814.05 CHEMICAL ADMIXTURES

- (A) **ACCELERATOR.** Materials to be incorporated in the PCC mix as an accelerator shall meet the requirements of AASHTO M 194, Type C or E as specified, except that the accelerating admixture shall contain not more than 500 parts per million chloride ion.  

Admixtures causing accelerated setting of cement in PCC shall not be used in PCC for sewer-water structures.
- (B) **RETARDER.** Materials to be incorporated into the PCC as a retarder shall meet the requirements of AASHTO M 194, Type B or D as specified.
- (C) **WATER REDUCER.** Materials to be incorporated in the PCC as a water reducer shall meet the requirements of AASHTO M 194, Type A or D as specified.

High range water reducing admixtures (super-plasticizer) shall meet the requirements of AASHTO M 194, Type F.

**814.06 COLOR ADMIXTURES**

- (A) **CARBON POWDER.** Carbon powder for darkening PCC shall be Carbon Black (concrete grade) in accordance with ASTM C 979. The material shall be such that it will not float and will be uniformly and completely dispersed throughout the plastic PCC.
- (B) **OTHER.** Materials other than carbon powder used for coloring PCC shall be as required by the contract documents and shall conform to appropriate requirements of ASTM C 979.

**815 METAL FOR STRUCTURES****815.01 STRUCTURAL STEEL**

The materials shall conform to the specifications as listed in the following tabulation with modifications and additions as specified herein.

- (A) **STRUCTURAL CARBON STEEL.** ASTM A 36.
- (B) **HIGH-STRENGTH LOW ALLOY STRUCTURAL STEEL.** High-strength low-alloy structural steel, high-strength low-alloy structural steel for welding, and high-strength structural steel for bolted construction shall conform to:
  - (1) High-Strength Low-Alloy Structural Steel – AASHTO M 270.
  - (2) High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality (Grades 42 and 50 for welding) – ASTM A572.
  - (3) High-Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4-in. Thick – ASTM A 588.
- (C) **HIGH-YIELD STRENGTH, QUENCHED, AND TEMPERED ALLOY STEEL PLATE.**
  - (1) High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding ASTM A 514.
  - (2) Pressure Vessel Plates, Alloy Steel, High Strength, Quenched and Tempered-ASTM A 517.
  - (3) Seamless mechanical tubing (Maximum tensile strength 145,000 psi) – ASTM A 519.
- (D) **HIGH-STRENGTH FASTENERS**
  - (1) Bolts – AASHTO M 164, or AASHTO M 253, and Table 815A
  - (2) Nuts – AASHTO M 291, and Table 815A
  - (3) Washers – AASHTO M 293 and Table 815B
  - (4) Direct Tension Indicators-ASTM F 959
- (E) **WELDING ELECTRODES.** Welding electrodes, electrode testing, and certification shall conform to the requirements of the AASHTO AWS D 1.1 Structural Welding Code and AASHTO AWS D 1.5 Bridge Welding Code. incorporates.
- (F) **WELDED STUDS.** Welding of studs shall meet the requirements of AASHTO AWS D 1.1 Structural Welding Code and AASHTO AWS D 1.5 Bridge Welding Code.
- (G) **PINS AND ROLLERS.**
  - (1) Greater than 9 inches diameter – AASHTO M 102, Class E.
  - (2) Nine inches diameter or less – AASHTO M 102, Class E or AASHTO M 169, Grade 1022 to 1030 inclusive; with minimum Rockwell Scale B Hardness of 85 or minimum tensile strength of 72,000 psi and minimum yield point of 36,000 psi.

**(H) ANCHOR BOLTS.** ASTM A 307.

**(I) CAST STEEL.** AASHTO M 103, Grade 65-35, fully annealed.

**(J) TOUGHNESS.** All structural steel plate within the tension zone shall meet the longitudinal Charpy V-notch impact requirements determined and specified in AASHTO M 270 for Zone 2:

<b>Material (AASHTO)</b>	<b>Supplemental Requirement</b>
M 161	S1
M 183	S3
M 188	S1
M 222	S1
M 223	S2
M 244	S3

**(L) CARBON STEEL EXTERNALLY THREADED FASTENERS.** ASTM A 307.

#### **815.02 PRESTRESSING REINFORCEMENT**

Prestressing reinforcement shall be high-tensile-strength steel wire, high-tensile-strength seven-wire strand, or high-tensile-strength alloy bars as specified in the contract documents.

All wire, strand, or bars to be shipped to the site shall be assigned a lot number and tagged for identification purposes. Anchorage assemblies to be shipped shall be likewise identified.

All samples submitted shall be representative of the lot to be furnished and, in the case of wire or strand, shall be taken from the same master roll.

All of the materials specified for testing shall be furnished free of cost and shall be delivered in time for tests to be made well in advance of anticipated time of use.

Where the Chief Engineer intends to require nondestructive testing of one or more parts of the structure, special specifications shall be drawn giving the required details of the work.

The vendor shall furnish for testing the following samples selected from each lot including heat and reel numbers for each sample. If ordered by the Chief Engineer, the selection of samples shall be made at the manufacturer's plant by the inspector.

#### **(A) SAMPLES.**

- (1) PRE-TENSIONING METHOD.** For pre-tensioned strands, one sample at least 7 feet long shall be furnished in accordance with the requirements of paragraph 9.1 of AASHTO M 203.
- (2) POST-TENSIONING METHOD.** The following lengths shall be furnished:
  - (a)** For wires requiring heading – 5 feet.

- (b) For wires not requiring heading – sufficient length to make up one parallel-lay cable 5 feet long consisting of the same number of wires as the cable to be furnished.
- (c) For strand to be furnished with fittings – 5 feet between near ends of fittings.
- (d) For bars to be furnished with threaded ends and nuts – 5 feet between threads at ends.
- (e) Anchorage assemblies – Two anchorage assemblies shall be furnished, complete with distribution plates of each size and type to be used, if anchorage assemblies are not attached to reinforcement samples.

**(B) HIGH-TENSILE-STRENGTH STEEL.** The high-tensile-strength steel shall be made by the basic-oxygen, open hearth, or electric-furnace process. The wire shall be cold drawn to size and suitably stress-relieved after cold drawing by a continuous strand heat treatment to produce the prescribed mechanical properties.

High-tensile-strength steel wire shall conform to the requirements of AASHTO M 204.

**(C) HIGH-TENSILE-STRENGTH SEVEN WIRE STRAND.** High-tensile-strength seven-wire strand shall conform to the requirements of AASHTO M 203, for the grade specified in the contract documents.

**(D) HIGH-TENSILE-STRENGTH ALLOY BARS.** High-tensile-strength alloy bars shall be stress relieved and then cold stretched to a minimum of 130,000 psi. After cold stretching, the physical properties shall be as follows:

Minimum ultimate tensile strength	145,000 psi
Minimum yield strength, measured by the 0.7 percent extension under load method shall not be less than	130,000 psi
Minimum modulus of elasticity	25,000,000 psi
Minimum elongation in 20-bar diameters after rupture	4 percent
Diameter tolerance	+0.03", -0.01"

**815.03 STEEL CASTINGS**

**(A) STEEL CASTINGS FOR HIGHWAY BRIDGES.** Steel castings for use in highway bridge components shall conform to AASHTO M 103, Grade 70-36.

**(B) CHROMIUM ALLOY-STEEL CASTINGS.** Chromium alloy steel castings shall conform to AASHTO M 163, Grade CA-15.

**815.04 GRAY IRON CASTINGS**

Gray iron castings shall conform to the requirements of AASHTO M 105, Class 30 A.

Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects in position affecting their strength and value for the service intended.

Castings shall be boldly filleted at the angles and the arrises shall be sharp and perfect.

All castings must be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.

#### **815.05 DUCTILE IRON CASTINGS**

Ductile iron castings shall conform to the Specifications for Ductile Iron Castings, ASTM A 536, Grade 60-40-18, unless otherwise specified. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings weighing more than 1000 pounds to determine that the required quality is obtained in the castings in the finished condition.

Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in position affecting their strength and value for the service intended.

Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect.

All castings must be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.

#### **815.06 BRONZE CASTINGS**

Bronze castings shall conform to AASHTO M 107. Alloy No. 913 or 911.

#### **815.07 CARBON STEEL FORGINGS**

Steel forgings shall conform to AASHTO M 102, Class C.

#### **815.08 ALLOY STEEL FORGINGS**

Alloy steel forgings shall conform to AASHTO M 102, Class A.

#### **815.09 COLD FINISHED CARBON STEEL SHAFTING**

Cold finished carbon steel shafting shall conform to AASHTO M 169, Grade Designation 1016 to 1030, inclusive.

#### **815.10 COPPER-ALLOY PLATES**

Copper-Alloy Plates shall conform to ASTM B 100.

#### **815.11 SHEET ZINC**

Sheet zinc shall conform to ASTM B-69, Type II.

**815.12 COPPER FLASHING**

All copper flashing shall be made of 16 oz. copper conforming to the requirements of, soft. It shall be machine bent to shapes and widths shown on the plans.

**815.13 TURNBUCKLES**

Turnbuckles for steel beam guardrail shall conform to AASHTO M 269.

Tensile properties shall be determined in accordance with ASTM A 370. Tensile tests of finished anchors and stud shall be made on units welded to test plates. If fracture occurs outside the middle half of the gage length, the test shall be repeated.

**TABLE 815 A BOLT AND NUT DIMENSIONS<sup>A</sup>**

Nominal Bolt Sizes D	Heavy Hexagon Structural Bolts			Heavy Semi-Finished Hexagon Nuts	
	Width Across	Thread Width Across			
	Flats F	Height H	Length T	Flats W	Height H
1/2	7/8	5/16	1	7/8	31/64
5/8	1-1/16	25/64	1-1/4	1-1/16	39/64
3/4	1-1/4	15/32	1-3/8	1-1/4	47/64
7/8	1-7/16	35/64	1-1/2	1-7/16	55/64
1	1-5/8	39/64	1-3/4	1-5/8	63/64
1-1/8	1-13/16	11/16	2	1-13/16	1-7/64
1-1/4	2	25/32	2	2	1-7/32
1-3/8	1-3/16	27/32	2-1/4	2-3/16	1-11/32
1-1/2	2-3/8	15/16	1-1/4	2-3/8	1-15/32

**TABLE 815 B WASHER DIMENSIONS<sup>A</sup>**

Circular Washers					Square or Rectangular Beveled Washers for American Standard Beams and Channels		
Bolt size D	Nominal Outside Diameter <sup>b</sup>	Nominal Diameter of Hole	Thickness		Minimum Side Dimension	Mean Thickness	Slope of Taper in Thickness
			Min.	Max.			
1/2	1-1/16	17/32	.097	.177			
5/8	1-5/16	21/32	.122	.177	1-3/4	5/16	1:6
3/4	1-15/32	13/16	.122	.177	1-3/4	5/16	1:6
7/8	1-3/4	15/16	.136	.177	1-3/4	5/16	1:6
1	2	1-1/16	.136	.177	1-3/4	5/16	1:6
1-1/8	2-1/4	1-1/4	.136	.177	1-3/4	5/16	1:6
1-1/4	2-1/2	1-3/8	.136	.177	2-1/4	5/16	1:6
1-3/8	2-3/4	1-1/2	.136	.177	2-1/4	5/16	1:6
1-1/2	3	1-5/8	.136	.177	2-1/4	5/16	1:6
1-3/4	3-3/8	1-7/8	.178 <sub>c</sub>	.28 <sup>c</sup>	2-1/4	5/16	1:6
2	3-3/4	2-1/8	.178	.28 <sup>d</sup>	2-1/4	5/16	1:6
>2,#4	2D-1/2	D + 1/8	.24 <sup>d</sup>	.34 <sup>d</sup>			

<sup>a</sup> Dimensions in inches ..... <sup>c</sup> 3/16 nominal

<sup>b</sup> May be exceeded by 1/4 inch ..... <sup>d</sup> 1/4 inch nominal

## 816 PILES

### 816.01 TIMBER PILES

Timber piles shall meet the requirements of AASHTO M 168 for piling.

Timber piles shall be treated with creosote oil by the empty cell process. Creosote oil for piles shall conform to AASHTO M 133. The preservative treatment shall be in accordance with AASHTO M 133.

### 816.02 STEEL H-PILES

Steel H-Piles shall conform to ASTM A36.

The piles shall be of the size and weight per foot indicated on the plans, and shall conform at the time of driving to camber and sweep as permitted by allowable mill tolerances.

Piles including splice pieces shall be cleaned of all rust and other foreign matter prior to shipment.

Cap plates for H-Pile Thrust Block shall be steel plate per ASTM A 36 of appropriate size and thickness.

### 816.03 CAST-IN-PLACE PILES

Metal shells shall be made of structural steel having a minimum tensile yield strength of not less than 50,000 psi. The metal of shells driven with a mandrel shall have a minimum allowable thickness of No. 18 U.S.S.G. Metal shells directly driven without a mandrel shall have a minimum allowable thickness of No. 11 U.S.S.G. Metal shells be of sufficient strength and rigidity to permit driving, and to prevent distortion caused by soil pressures or the driving of adjacent piles, until filled with concrete. The shells shall also be sufficiently watertight to exclude water during the placing of concrete.

The piles shall preferably be tapered and shall have a minimum tip diameter of 8 inches and minimum butt diameter of 12 inches. Combination piles with a tapered section and a constant section, if used, shall have a minimum tip diameter of 8 inches and a minimum butt diameter of 12 inches. The tapers shall conform with the manufacturer's standards. Piles of constant section, if used, shall have a minimum diameter of 12 inches. All diameters referred to herein are outside diameters.

### 816.04 UNFILLED TUBULAR STEEL PILES

The metal for unfilled tubular steel piles shall conform to the requirements of ASTM A 252, Grade 2 and the chemical requirements of ASTM A 53, Grade B.

### 816.05 BITUMEN COATING FOR STEEL PILES

Canal liner bitumen (ASTM D 2521) shall be used for coating. The primer shall conform to the requirements of ASTM D 41.

**817 PORTLAND CEMENT CONCRETE MIXTURES****817.01 PCC MIX DESIGN**

**(A) GENERAL.** Concrete shall be proportioned within allowable tolerances of an approved mix design. An approved mix design shall consist of an approved concrete producer, materials sources, class of concrete, and material types and proportions. Mix designs for each project must be approved by the Chief Engineer. Approval of a mix design for a specific project, purpose or use does not approve its use for any other project, purpose or use.

Mix design information submitted shall have been obtained from measurements on a trial mix prepared with ingredients from the same source(s) as proposed for use. Mix designs shall have been prepared within 12 months prior to the date submitted. In the event such a mix design is not in full compliance with applicable specifications, further production of that PCC mix shall be suspended until an approved mix design has been obtained in accordance with these specification requirements. Any deviation from the approved mix design will require the approval of the Chief Engineer.

Methods of proportioning mix designs shall be in conformance with ACI 211.1 for normal and heavy weight concrete, ACI 211.2 for lightweight concrete, and ACI 211.3 for no slump concrete.

Each PCC mix design submitted for approval shall include the following:

1. Name and Location of Project and Contract Number
2. Name and Address of Contractor
3. Name and Address of Concrete Producer
4. Mix Design Designation(s)
5. Class(es) of Concrete
6. Uses of Concrete
7. Source Name and Location of Fine Aggregate, Coarse Aggregate, Cement, Admixtures and Water.
8. Type of Cement
9. Cement Content in pounds per cubic yard of concrete
10. Saturated Surface Dry Weight of Coarse and Fine Aggregates in pound per cubic yard of concrete.
11. Water Content, including free moisture in the aggregate, plus water in the drum, exclusive of absorbed moisture.
12. Dosage of Admixture(s).
13. Sieve Analysis of Fine and Coarse Aggregate.
14. Absorption of Fine and Coarse Aggregate.
15. Bulk Specific Gravity (dry and SSD) of Fine and Coarse Aggregate.

16. Dry Rodded Unit Weight of Coarse Aggregate in pounds per cubic foot.
17. Fineness Modulus (FM) of Fine Aggregate.
18. Materials Certification for Cement, Admixtures and Aggregates.
19. Slump of Plastic Concrete in inches.
20. Air Content of Plastic Concrete in percent by volume.
21. Unit Weight of Plastic Concrete in pounds per cubic foot.
22. Seven Day Compressive Strength of Concrete in pounds per square inch.
23. Twenty-eight Day Compressive Strength of Concrete in pounds per square inch.

Up to 50 calendar days may be required for review of a proposed PCC mix design in Category 1 or 3 after it has been submitted for approval. In order to minimize the time between Notice to Proceed and completion of mix design reviews for Category 3 submittals, the apparently successful bidding Contractor may submit proposed mix designs for project approval at anytime after bid opening date. Review of alternate mix designs may require longer than 50 calendar days.

- (B) PROPORTIONS.** Concrete mixtures shall be proportioned so as to secure a workable, homogeneous, placeable mixture which meets the requirements of 817.03 for its intended use. The concrete shall be proportioned by weight and shall consist of portland cement, fine aggregate, coarse aggregate, water, admixture(s) and other ingredients as may be specified. Unless specified otherwise, strength values are the average of two companion test cylinders.

### 817.02 MATERIALS

Portland Cement – 801.01

Granulated Iron Blast Furnace Slag – 801.04

Masonry Cement – 801.02

Fly Ash – 801.05

Fine Aggregate

1. Normal Weight – 803.01

2. Light Weight – 803.07

Coarse Aggregate

1. Normal Weight – 803.02

2. Light Weight – 803.07

Admixtures

1. Air Entraining – 814.04

2. Chemical Admixtures – 814.05

3. Color – 814.06

Water – 822.01

Formulated Latex Modifier – 821.15

**817.03 DESIGN CRITERIA**

Proportions of concrete shall be such that the design criteria herein are met for the respective class of concrete.

**(A) CLASSES OF CONCRETE.** Unless otherwise specified, the following classes of concrete shall be used.

CLASS	DESIGNATION	USES
A	Structural Trap Rock	Bridge Decks, sidewalks, approach slabs, and medians for superstructures. Suitable for all uses specified for Class B, Structural.
B	Structural	Reinforced structures, footings, slabs, beams, girders, columns, piers, abutments, walls, arch ribs, box culverts, precast piles, traffic barriers, and cribbing. Sewer and water work except thrust blocks and pipe cradle.
C	High Early Strength	For special and emergency uses as approved by the Chief Engineer.
D	Prestressed	Used for prestressed or post tensioned members.
E	Paving	Alleys, alley and driveway entrances, curbs and gutters, pavements and base.
F	General	For general use and in sidewalks, bike paths or as specified.
H	Lightweight	As specified.
I	Low Slump	As specified.
J	Latex Modified	As specified.

**(B) DESIGN REQUIREMENTS.** Granulated slag may be used in an amount not to exceed 50 percent by weight of cement. Cement factor and water-cement ratio is determined on basis of combined granulated slag and cement weight.

Fly ash and granulated slag may not be used in the same mixture.

**TABLE 817.03 - PORTLAND CEMENT CONCRETE MIXTURES  
The Concrete Mixes Shall Conform to the Following:**

Class Designation	Min. 28 Day Compressive Strength (psi) <sup>b</sup>	Min. Cement Content (Lbs./Yd <sup>3</sup> )	Max. Water (Lbs. Water per Lbs. Cement)	Coarse Aggregate Size No. <sup>b</sup>	Slump (In.) <sup>c</sup>	Field Air Content (% by Volume)	Max. Unit Weight (Lbs./Ft. <sup>3</sup> )
A <sup>4b</sup> STRUCTURAL TRAP ROCK	4,500	658	0.44	57 or 67	2-3	5-8	
B <sup>6b</sup> STRUCTURAL	4,500	658	0.44	57 or 67	2-3	5-8	
C <sup>6b</sup> HIGH EARLY	3,000 <sup>2d</sup> (HS)	800	0.38	57	0-3	5-8	
D <sup>6b</sup> PRESTRESSED	5,000	680	0.43	57	0-4	5-8	
E <sup>6b</sup> PAVING	3,500	565	0.49	57, 57 & 4 or 67 & 4	0-3	5-8	
F <sup>6b</sup> GENERAL	3,500	565	0.49	67, 57, 57 & 4 or 67 & 4	1-5	5-8	
G PIPE CRADLE (ONLY)	2,500	470	0.55	67, 57	1-5	5-8	
H1 <sup>4b</sup> LIGHTWEIGHT	4,000	658	0.44	3/4 to 4	0-4	5-8	122-PLASTIC 117- 28 DAD*
H2 <sup>6b</sup> LIGHTWEIGHT	4,000	658	0.44	3/4 to 4	0-4	5-8	115-PLASTIC 110-28 DAD*
I <sup>6b</sup> LOW SLUMP	4,500	820	0.45	78 <sup>b</sup>	1 MAX.	5-8	
J <sup>6b</sup> LATEX MODIFIED	4,000	660	0.40	7	4-6	3-7	

\*DAD = Day Air Dry

- The Materials Engineer may approve mix designs, pending 28 day strength results based on the 7 day compressive strength which results that equals or exceeds 85 percent of the compressive strength and provided that no accelerator or early strength cements are used (except for Class "C"). The compressive strength is defined as the average of 2 cylinders made in the field and cured in the laboratory.
- Crushed trap rock shall be used in class I Low Slump concrete if used in concrete for bridge deck, sidewalk and for median superstructures. Polish susceptible aggregates as defined in 402.02(E) shall not be used for concrete pavement surfaces.
- A maximum slump as limited by the mix design will be allowed for concrete approved with water reducing admixtures. High range water reducer may be used for concrete to be placed at higher slump with the approval of the Engineer provided that there is no aggregate segregation and the entrained air of the concrete at point of placement is within acceptable range.
- Polish susceptible fine aggregates as defined in 402.02(E) shall not be used for concrete pavement surfaces.
- Latex emulsion shall not exceed 3.5 gallons per 94 pounds cement. The latex will weigh approximately 8.40 to 8.55 pounds per gallon.
- Latex emulsion is included as part of the maximum water.
- Fly ash may be substituted for cement such that not more than 15 percent by weight of cement is removed. The mix may require more fly ash added than cement removed. Cement factor and water-cement ratio determined on basis of combined fly ash (replacing the cement) and cement weight. Granulated slag may be used in an amount not to exceed 40 percent by weight of cement. Cement factor and water-cement ratio is determined on basis of combined granulated slag and cement. Fly ash and granulated slag may not be used in the same mixture for cement substitute.
- The chert content of the combined coarse aggregate shall be less than 3.0 percent as per AASHTO M80 Class A.
- Coarse and Fine aggregate shall conform to 803.07.
- Must be approved by the Engineer prior to use.

- a. The Chief Engineer may approve, pending 28 day strength results, mix designs on the basis that 7 day compressive strength results equal or exceed 85 percent of the minimum average strength requirement as determined in 817.01(B) provided no accelerators or early strength cements are used.
- b. Crushed traprock per 803.02 shall be used in Class 1 concrete if used in concrete for bridge deck, sidewalk and median of superstructures.
- c. Consistency limits are those allowable with water. A maximum slump as limited by the mix design will be allowed for concrete approved with water reducing admixtures.
- d. Fine aggregate shall conform to 803.01.
- e. Light weight fine aggregate shall conform to 803.07.
- f. Latex emulsion conforming to 822.15 shall be added in an amount of 3.5 gallons per 94 pounds of cement. The latex will weigh approximately 8.40 to 8.55 pounds per gallon.

Proportions of cement to fine aggregate to coarse aggregate on a dry weight basis shall be 1 to 2.5 to 2.0 with a tolerance of 10 percent on the fine and coarse aggregate ratios.

- g. Latex emulsion is included as part of the maximum water.
- h. Fly ash may be substituted for cement such that not more than 15 percent by weight of cement is removed. The mix may require more fly ash added than cement removed. Cement factor and water-cement ratio determined on basis of combined fly ash and cement weight. Fly ash shall conform to the requirements of 801.05.

### **(C) PROTECTION OF CONCRETE AGAINST ALKALI REACTIVITY**

Fine and coarse aggregates for use in concrete that will subject to wetting, extended exposure to humid atmospheric conditions or contact with moist ground shall not contain any material that is deleteriously reactive with alkalies in the cement in an amount sufficient to cause excessive expansion of mortar or concrete, except that if such materials are present in injurious amounts, the fine and coarse aggregates may be used with a cement containing less than 0.6 percent alkalies calculated as sodium oxide or with the addition of a material that has been shown to prevent harmful expansion due to the alkali-aggregate reaction.

When the concrete will be subjected to external sources of alkalis and/or chlorides, the aggregates used shall not contain more than 3 % reactive constituents as defined by ASTM C 295, and pass at least one of the following criteria as may be applicable in accordance with ASTM C289, C227, C586, C9 and C1260.

**817.04 DESIGN ADJUSTMENTS**

Concrete mix design can be revised to improve placement during cold, hot or unusual weather as long as the requirements of 803 are met and the revision is approved by the Chief Engineer.

When sources of materials change from those of the approved mix design or when the fineness modulus of the fine aggregate changes by more than 0.20 from the mix design, the mix design will be reviewed and may require a new design.

In the event concrete with the required workability or consistency can not be obtained within the maximum water cement ratio with the materials furnished by the Contractor or producer, changes shall be made as necessary to secure the desired properties subject to the requirements of 817 and the approval of the Chief Engineer.

**817.05 LOW PERMEABILITY STRUCTURAL CONCRETE**

At least two trial batches shall be prepared using approved Portland Cement Concrete (PCC) mix design materials. Test specimens shall be cast by the Contractor and tested by a certified laboratory for permeability and strength at least thirty (30) calendar days prior to construction. The permeability samples shall be cylindrical, four (4) inches in diameter and six (6) inches in length. The samples shall be moist cured as per ASTM C-39, except that the last twenty-one days shall be cured at a temperature of  $38^{\circ}\text{C} \pm 6^{\circ}$  ( $100^{\circ}\text{F} \pm 10^{\circ}$ ). Test cylinders shall be tested at twenty-eight (28) calendar days as per ASTM C-1202 and reported as the average of two (2) test specimens from each lot. (100 cubic yards). Permeability values obtained for trial batches shall be 500 coulombs below the maximum values specified in Table 817.05.

**Acceptance Tests**

A lot shall be a day's production of PCC for the job. For each set of cylinders made for compressive strength tests, two additional cylinders shall be made for the permeability testing purposes.

For all classes of PCC, initially one set of permeability cylinders shall be tested in accordance with AASHTO T-277. If the average coulomb value for this test is less than the value shown in Table 817.05, the lot will be accepted at the full contract unit price.

If the average test result exceeds the coulomb value in Table 817.05, payment for PCC in that element (in-place cost) shall be reduced 0.005% for each coulomb above the coulomb value given in Table 817.05. However, the reduction in price shall not exceed 5% of the bid price of the PCC. PCC with a coulomb value that exceeds the maximum allowed in Table 817.05 by 1000 coulombs shall be rejected. However, bridge deck PCC with a coulomb value exceeding the maximum by over 1000 coulombs or more may be accepted by the Chief Engineer at 95% of the contract bid price provided it meets the minimum compressive strength requirement, and the Contractor applies an epoxy PCC overlay at his own expense. In such cases, deck grooving will not be required. Any adjustments to the roadway grade shall be made as required by the Chief Engineer at the Contractor's expense.

PCC abutments and pier caps with a coulomb value that exceeds the maximum required in Table 817.05 by more than 1000 coulombs may be accepted at 95% of the contract

bid price provided that the compressive strength meets the contract minimum specified requirements and that the Contractor applies an approved epoxy overlay, at his expense.

The reduction in the bid price specified above shall be applied to the total volume of PCC in the bridge members (deck slab of a single span, deck slab of a group of continuous spans, pier or abutments), of which any portion of the PCC in the member did not meet the permeability test requirements.

**Table 817.05-Coulomb Requirements**

<b><u>PCC Class Requirement</u></b>	<b><u>Approved Use(s)</u></b>	<b><u>Coulomb</u></b>
Class A Structural (Trap Rock)	Bridge- Decks, Sidewalks Approach Slabs, Medians For Superstructures, Suitable for all Class B Structural specified uses	1,500 Max
Class B Structural	Reinforced Structures- Footings, Beams, Girders, Columns, Piers, Abutments, Walls, Arched Ribs, Box Culverts, Pre-cast Piles, Traffic Barriers and Cribbing	2,000 Max.
Class H Lightweight	As Specified	1,500 Max.

**817.06 CONSTRUCTION METHODS.**

Aggregates and portland cement shall be proportioned by weight; water may be proportioned by volume or by weight. Batch weights of aggregates for the concrete shall be corrected for free moisture, as calculated from moisture determination performed by the Contractor. These moisture determinations shall be made at a minimum of every 4 hours PCC consistency shall be checked in accordance with 501.15.

All tolerances for measurement of materials will be applied to the approved mix design quantities. Tolerances for proportioning are as follows:

<b>Material</b>	<b>Tolerance, Percent by Weight of Mix Design</b>
Cement	+4,-0
Coarse Aggregate	±2
Fine Aggregate	±2
Water	±1
Admixtures	±3

The approved mix design shall not be changed except as provided below:

- (1) Adjustment for variation in fineness modules (FM). If the FM of the fine aggregate exceeds the limits specified in 803.01, the mix design shall be adjusted as provided in 817.04.
- (2) Adjustments for new materials. Change in source or character of the materials shall be made only after tests on trial mixes and with the Chief Engineer's written approval.

**818 BITUMINOUS CONCRETE MIXTURES****818.01 GENERAL**

The Contractor shall submit to the Chief Engineer for approval a job mix formula for each type of bituminous mixture proposed for use. Approval of a job mix formula for a specific project, purpose, or use does not approve its use for any other project, purpose, or use.

Production of bituminous mixtures shall not commence until an approved job mix formula has been obtained in accordance with these specification requirements. Any deviation from the approved job mix formula or approved source of materials shall require the approval by the Chief Engineer.

The Contractor shall allow 30 working days to receive approval or rejection of a proposed job mix formula after it has been submitted to the Chief Engineer for approval.

It is the Contractor's responsibility to furnish the Chief Engineer the necessary quantity of materials for each proposed job mix formula to yield 75 pounds of bituminous mixture, with each job mix formula submitted. Each job mix formula submitted for approval shall include the following information:

1. Name of project and location.
2. Name of Contractor.
3. Name of producer or supplier.
4. Name and class or type of bituminous mixture.
5. Proposed use of bituminous mixture.
6. Name, source, and amount (percent by weight of total mixture) of all ingredient materials proposed for use, including:
  - a. Bitumen
  - b. Coarse aggregate
  - c. Fine aggregate
  - d. Mineral filler
  - e. Hydrated Lime or Liquid Anti Strip Additive
  - f. Other
7. Gradation of combined aggregate and mineral filler, expressed by percent passing required sieve sizes.
8. Mixing temperature.
9. Temperature of mix when delivered to the spreader and finisher.
10. Gradation test results for each aggregate size and source proposed.
11. Gradation test results of composite mixture.

12. Tests performed on the total mixture shall be prepared in conformance with AASHTO M323.

A maximum of one primary and one alternate job mix formula per mix type will be approved per contractor and/or supplier per calendar year. An alternate job mix formula is either an alternate supplier or a single supplier with different combinations of materials.

### 818.02 DESIGN CRITERIA

Job mix formulas for bituminous mixtures submitted for approval as required in 818.01 shall be based on the following:

- (A) **MIX DESIGN** –The Contractor shall develop a Superpave mix design in conformance with AASHTO R-35. HMA Superpave mixes, i.e. 12.5 mm surface course, 9.5 mm leveling and surface course, and 19.0 mm and 25.0 mm base course or as directed by the Chief Engineer, shall conform to the specifications for Superpave Volumetric Mix Design, AASHTO M-323-04, and shall be designed for thirty (30) million Equivalent Axle Loading (ESAL).

The Contractor shall not use crushed, re-cycled asphalt pavement material (RAP) or crushed glass roof shingles from manufacturing waste.

- (B) **AGGREGATES** – Aggregates shall conform to Section 803.03, 803.04 and AASHTO MP 2, with the exception that the aggregate retained on the No. 4 sieve shall be tested for flat and elongated particles in conformance with ASTM D4791.
- (C) **MIX DESIGN APPROVAL** –Documents containing the data from the Contractor’s laboratory study shall be submitted to the Chief Engineer for tentative approval at least two weeks prior to paving operations, using DDOT-approved AASHTO software, and shall include the following:
- (1) Mix designation and Contract Number shall be on Contract Documents
  - (2) Source and percentage of aggregate
  - (3) Source, percentage, and grade of performance graded asphalt binder
  - (4) Anticipated gradation and proportion of each component aggregate
  - (5) Combined cold feed grading, extracted grading, or ignited grading
  - (6) Plant where HMA mix will be produced
  - (7) Plant target mixing temperature based on viscosity of 0.22 Pascal second.
  - (8) Percent passing No. 200 sieve removed by dust collection system
  - (9) Ratio of dust to binder material on effective asphalt
  - (10) Maximum specific gravity at the target binder content
  - (11) Mix design grading plotted on 0.45 power gradation chart
  - (12) Tensile strength ratio and worksheet
  - (13) The gyratory compaction curve for  $N_{max}$
  - (14) The bulk specific gravity at  $N_{Design}$  gyrations

- (15) the air void content (percent Va) at  $N_{\text{initial}}$ ,  $N_{\text{design}}$ , and  $N_{\text{max}}$  gyrations.
- (16) The voids in the mineral aggregate (percent VMA) and the voids filled with asphalt (percent VFA) at  $N_{\text{Design}}$  gyrations (TP4)
- (17) The slope of the gyratory compaction curve

**(D) ALL CONSENSUS AND SOURCE PROPERTIES**

- (1) Coarse aggregate angularity
- (2) Flat and elongated
- (3) Sand equivalent
- (4) Uncompacted void content of fine aggregate
- (5) Bulk and apparent specific gravity of coarse and fine aggregate
- (6) Absorption of coarse and fine aggregate

Mix designs submitted to the Chief Engineer for approval shall be accompanied by a quantity of job mix formula aggregate and appropriate amount of required PG binder for ignition oven calibration.

If previous construction or performance experience has shown the proposed job mix design to be unsatisfactory, the Chief Engineer may require the Contractor to submit a more suitable design.

If the Contractor proposes to change the source of aggregate used in the mix, the revised mix design shall be submitted with the information required. The conditions set forth above relative to initial submission shall apply. If a change in the Performance Grade binder source becomes necessary, DDOT requires an anti-stripping additive test in conformance with ASTM D 4867 before giving the final approval; DDOT approved anti-stripping is required in all AC mixtures.

- (E) FIELD VERIFICATION OF MIX DESIGN**—After receiving the tentative approval for the mix design from the Engineer, the Contractor shall conduct a field verification of the mix at the beginning of production in each plant. The certified personnel shall perform field verification. The verification samples shall be prepared as specified in AASHTO R-35-04. The Contractor shall notify the Chief Engineer at least two working days in advance of the scheduled verification.

**(F) VERIFICATION EVALUATION**

- (1) Initial verification shall consist of four samples tested for the parameters of the approved mix design.

These samples shall be randomly drawn from the first days' production. If the production of the first day is less than 500 tons, the Contractor may spread verification testing over the number of days needed to accumulate 500 tons. The verification testing shall be completed on the day when the production has reached 500 tons. The Contractor shall evaluate the verification test results.

- (2) If the mix produced by the plant conforms to the parameters, production may proceed without any changes. If the Contractor has submitted mixes with identical aggregate combinations and differing asphalt contents associated with changes in

ESAL loads, verification will be limited to volumetric analysis at the discretion of the Chief Engineer.

- (3) If the mix produced by the plant does not conform to the parameters, then an adjustment to the asphalt content or gradation may be made to bring the mix design requirements within acceptable levels.

Permissible adjustment limitations between approved Mix Design and Adjusted Mix Design are as follows:

<b>Test Property % *</b>	<b>Permissible Adjustment</b>
Larger than ½ inch sieve	±5
½ inch through No. 4 sieves	±4
No. 8 through No. 100 sieves	±3
No. 200 sieves	±1
Binder content	±0.2

\* The permissible adjustment for all mixes shall establish a job mix formula having targets outside the restricted zone. Superpave mixes shall be within control points.

When an adjustment is made to the mix design, a second verification shall be performed to ensure that the modified mix conforms to all design requirements. The time and tonnage limitations shall be as specified in (a) above. Material produced during this verification will be subject to removal as specified at the discretion of the Chief Engineer if it does not conform to specifications.

If the adjusted mix conforms to the mix design parameters, production may proceed; if it does not conform, production shall be suspended and a new mix design shall be submitted to the Chief Engineer for approval. The new mix design shall be designed as specified in AASHTO R-35-04.

- (4) Subsequent mix designs submitted due to non-conformance will be subject to removal at the discretion of the Chief Engineer. If the mix does not conform to (2) above during initial verification, production for the mix shall be suspended until the Chief Engineer takes corrective action.

**(G) PAVEMENT CORES** - The Contractor shall obtain pavement cores at the direction of the Chief Engineer within twenty-four (24) hours after lay-down.

**(H) STONE FILLED SHEET ASPHALT JOINT REPAIR AND SPALLS** - The fine aggregate shall meet the requirements of 803.03 (B). Anti-strip additive or hydrated line shall be added as needed to meet the requirements stated in 803.03(B). Stone filled asphalt shall have the following properties:

Property	Min	Max
Sieve Size		
% passing by weight		
3/8 inch	100	
No. 4	95	100

No. 10	75	95
No. 40	40	70
No. 80	15	40
No.200(a)	8	

- (a) The maximum dust to asphalt ratio by weight shall be 1.5 for stone filled asphalt.

Stability		
Lbs (AASHTO T245)		
Minimum	1000	
Flow		
0.01 in.		
(AASHTO T 245)	8	16
Air Voids, %	4	10
VMA, %		
Minimum		20
Plant Temp., ° F		
Aggregate, Max		350
Binder, Max		350
Mixture, Max		350
Street Temp., ° F avg		315 ± 25

Fine aggregates for stone-filled sheet asphalt surface shall meet the quality requirements of 803.03(A). The gradation of the fine aggregates or combination of fine aggregates shall be such that it will produce the specified bituminous mixture properties when combined with other mixed ingredients. The combined fine aggregates shall consist of not less than forty (40) percent by weight of crushed stones Grade No. 10 from an approved source containing from eight (8) to fifteen (15) percent fines passing the No. 200 sieve.

- (I) The potential moisture damage on all paving mixtures shall be evaluated in accordance with ASTM D 4867 without the freezing cycle. The minimum retained strength shall not be less than 75 percent of the unconditioned pair of test samples. When the minimum retained strength can not be obtained with anti-strip additive, hydrated lime in slurry form shall be used in place of or in addition to the anti-strip additive.
- (J) Proposed bituminous job mix formulas shall be adjusted by the addition or change of an anti-strip additive or hydrated lime.

## 819 HIGH PERFORMANCE BITUMINOUS COLD MIX PATCHING MATERIAL

### 819.01 DESCRIPTION.

The material shall consist of plant mixed or bagged stockpile patching bituminous mixture composed of a blend of mineral aggregate coated with bituminous material. The material shall be capable of being stocked for at least six months without stripping and shall be workable at all times.

The material must be able to be used at all times regardless of weather conditions. It must be suitable for use under adverse weather conditions and sub-freezing ambient road temperatures, and must bond equally well to dry, damp, or wet surfaces.

The material may not be used if it has stripped (more than 10% uncoated particles) or otherwise become unfit for use.

### 819.02 PERFORMANCE REQUIREMENTS.

Material must be ready to use directly from stockpile. There will be no mixing or preparation of the material required. The product must be sufficiently workable for placing with shovels, rakes, or other hand tools.

### 819.03 CURING TIME.

After application of material, traffic can immediately be directed over the repaired area. There is no need to block off or plate over the patched area. The material must be pressure-sensitive and cure faster with greater volumes of traffic.

### 819.04 RELIABILITY.

When placed in a pothole or utility cut, the material shall maintain its integrity as long as, or longer than, the surrounding, existing paving.

### 819.05 MATERIALS.

Coarse aggregates shall be crushed limestone from an approved source, dust free, and shall meet the quality requirements of 803.04(A), and the following grading requirements:

Sieve Designation	Percent Passing by Weight
$\frac{1}{4}$	100
No. 4	60-90
No. 8	5-30
No. 16	0-10
No. 50	0- 5
No. 200	1.5

Aggregates shall be delivered, handled and stored in a manner that prevents segregation, contamination and mixing of materials from other sources. If it is determined that the material source for previously approved material does not produce the required results, the material will be rejected.

The asphalt binder is to be added to the aggregate at a rate of approximately 5½% by weight of mix in an approved plant mixer. The liquid asphalt percentage shall not be lower than 5% or more than 6%; aggregates are to be thoroughly coated with asphalt binder.

The Contractor shall comply with the bituminous liquid manufacturer's application, handling, mixing and safety procedures.

## 820 STREET LIGHTING AND ELECTRICAL MATERIALS

### 820.01 GENERAL

- (A) Fluorescent luminaires, sign lighting luminaires, street lighting luminaires and standards, underpass luminaires, conduit, boxes, service control equipment cabinets, switches, circuit breakers, contractors, time switches, distribution panels, wire and cable, transformers, lamps, plugs, receptacles, and other necessary street lighting and electrical materials for complete systems shall meet the requirements herein and as shown on the plans.
- (B) The Contractor shall be responsible for submitting to the Traffic Services Administration (TSA) catalog cuts and/or samples of all materials to be furnished for traffic signal and street lighting work. Procurement of all such materials by the Contractor may not begin until written approval is obtained from the TSA.

The Contractor will submit three (3) catalog cuts along with one (1) sample for all parts and supplies that he proposes to use as part of this contract, and for specialty items which are not specifically covered by the Material Specifications. The Contract Administrator will return one copy of the catalog cut approved to the Contractor before any material is ordered. The sample will remain with the Contract Administrator during the life of the contract, and will be returned the Contractor at the end of the contract. Should the Contractor wish to make changes in the type or brand of material used, he will submit the catalog cuts and sample for approval as called for in this section before starting to use the material in the performance of the contract.

### 820.02 LIGHTING STANDARDS

Lighting standards including arms shall meet the requirements of AASHTO Specifications for the Design and Construction of Structural Supports for Highway Luminaires, shall conform to the District of Columbia Commissioners' Order 60-1090 and be fluted standard steel or aluminum as specified and shown on Traffic Services Administration Department of Transportation Drawing No. 2 or 2-AA, and installed at locations and in accordance with details shown on the plans and connected in accordance with the wiring diagrams. The wiring, depending on locations, may be either series or multiple.

A strain-relief cable grip shall be provided inside the pole to support the pole cable.

### 820.03 LUMINAIRES LAMPS AND GLOBES

- (A) **GENERAL.** Luminaires shall be suitable for use in a multiple circuit and shall provide for use of high pressure sodium vapor lamps, metal halide lamps or mercury vapor lamps as provided in the plans. The luminaires shall consist of housing, reflectors, refractor-holders, slip-fitters, and pole side mounted mogul lamp sockets, photocell receptacles, and integral, regulator time ballasts. The complete unit shall have uniform lines throughout, and thus aesthetically combine all components.
- (B) **DESCRIPTION.** The materials for luminaires, lamps and globes shall be in accordance with the following:

**1. Streetlights****a. Mercury Vapor****1. Physical**

Wattage: As specified in the contract document

Bulb Type: ED 37

Base Type: Mog

Bulb Material:

Bulb Coating:

Max Overall Length (In): 11.31

Max Overall Length (mm): 288.000

Diameter (In):

**2. Photometric:**

Average Life in Hours: 24000+

Lumens (Initial): 22600

Lumens (Mean): 14400

Color Temperature (k): 3900

Color Rendering Index (Ra) CRI (> or =): 50

Warm Up Time (min.) to 90%:

Hot Restart Time (min.) to 90%:

Effective Arc Length in inches:

Lighted Center Length (In.):

**3. Luminaire:**

Fixture Type-Open/Enclosed: O

Operating Position Code: U

**b. Metal Halide****1. Physical**

Wattage: As specified in the contract document

Bulb Type: ED 37

Base Type: Mogul

Bulb Material: Hard Glass

Bulb Coating: Clear

Max Overall Length (In.): 11.5

Max Overall Length (mm): 293.00

Bulb Nominal Diameter (In.): 4.62

**2. Photometric:**

Average Life in Hours: 15000H/20000V

Lumens (Initial): 36000V/33100H

Lumens (Mean): 23500V/22100H

Color Temperature (k): 4000

Color Rendering Index (Ra) CRI (&gt; or =): 65

Warm Up Time (min.) to 90%: 2-4

Hot Restart Time (min.) to 90%: 10-15

Effective Arc Length in inches: 1.2000

Lighted Center Length (In.): 7

**3. Luminaire:**

Fixture Type-Open/Enclosed: S

Operating Position Code: U

**4. Ballast Related Information:**

Minimum Ballast Open Circuit Voltage-RMS-Lag Ballast (Ballast A/B/C): 382

Minimum Ballast Open Circuit Voltage- Peak Lag Ballast (Ballast/A/B/C): 540

**c. High Pressure Sodium (HPS) Vapor Lamp****1. Physical:**

Wattage: As specified in the contract document

Bulb Type: ET23.5

Base Type: Mogul

Bulb Material:

Bulb Coating:

Max Overall Length (In): 7.75

Max Overall Length (mm) 197

Diameter (In): 2.94

**2. Photometric:**

Average Life in Hours: 24000+

Lumens (Initial):

Lumens (Mean):

Color Temperature (k):

Color Rendering Index (Ra) CRI (&gt; or =): 22

Warm Up Time (min.) to 90%:

Hot Restart Time (min.) to 90%: 1

Effective Arc Length in inches:

Lighted Center Length (In.): 5

All lamps are to be new unused and in manufactures wrappers. The Contractor will submit all lamp data to the Chief Engineer for approval before ordering. The Contractor will supply the Chief Engineer with copies of all manufactures lamp warranties. The Contractor will store all lamp according to manufactures specifications until installed and accepted by the District.

**d. High Pressure Sodium (HPS) Vapor Luminaire**

The wattage is specified in the contract documents.

The luminaire shall have a die-cast aluminum housing with a hinged optical door. The ballast shall be mounted on a separate detachable die-cast door, which can be easily removed from the main housing. The ballast shall be pre-wired with quick disconnecting plugs to the lamp socket and dead back terminal block, requiring only connection of the phase conductors to the terminal block. The one-piece pipe clamp shall contain 4 bolts that do not pass through the housing. Clamping with only two bolts is not acceptable. The clamp must be able to accept a 1 1/4 to 2 inch pipe bracket without having to rearrange the clamp.

The ballast shall be a 120-volt magnetic regulator type for all 70W through 150 W luminaires and a magnetic regulator multi tap 120/208/240/277 Volt for all 250W and 400W luminaires. The ballast shall start and operate the lamp in ambient temperatures down to -40 F. The ballast shall be in full compliance with lamp-ballast specifications from the lamp manufacturer at the time of manufacture.

The interior components in the luminaire shall be arranged in such a manner that there is ample space for access to the wiring. Cables shall not be in close proximity to the ballast and shall be color-coded. The starter shall be placed in an open location for easy access.

The luminaire shall contain a formed aluminum reflector and a flat heat/impact resistant glass lens. The optical assembly shall not allow light above 90 degrees. The luminaire shall contain a non-wicking felt gasket for all 70W through 150W luminaires and a filter for all 250W and 400W luminaires.

The luminaire shall be provided with a photocell receptacle, which can be directionally adjusted without the use of tools.

The luminaire shall be set to provide an IES type 3 cut-off distribution pattern. The luminaire shall be marked, using standard EE-1 NEMA marking, showing the lamp type and wattage. The marking shall be affixed to the underside of the luminaire's housing and to the rear of the reflector. The luminaire shall be equivalent to GE M-250A2 power-door

**e. Metal Halide Luminaire**

The wattage is specified in the contract document.

The cut-off luminaire shall be a two door type with the ballast assembly mounted on a separate removable door. The ballast shall be pre-wired to the lamp socket and the dead back terminal block, requiring that the customer make only the connection of the phase conductors to the terminal block. The one piece pipe clamp shall contain 4 bolts that do not pass through the housing. The clamp must be able to accept 1 1/4 to 2 inch pipe bracket without having to rearrange the clamp. The ballast shall be a 120/208/240/277 volt Auto-regulator type, capable of starting and operating one 400W Metal Halide lamp within the limits specified by the lamp manufacturer. The ballast must start and operate the lamp in ambient temperatures down to -20 degrees F for the rated life of the lamp. Ballast primary current during starting must not exceed normal operating current. The lamp current crest factor shall not exceed 1.8 for +10 percent line voltage variation at and lamp wattage from nominal through life. Lamp ballast system power factor shall not drop below 90 percent for +10 percent line voltage variation at any voltage from nominal through life. The luminaire shall contain a formed aluminum reflector and a flat heat/impact resistant glass lens. The optical assembly shall not allow light above 90 degrees. The luminaire must contain a filter to keep out contaminants.

**f. Twist Lock Photo Electric Controls****g. Electronic Photocontrol and Cycle Detection Device**

Photoelectric controls shall meet or exceed all requirements of ANSI C 136.24 and shall meet the following:

1. Turn ON light level:  $1.5 \pm 0.5$  ftc.
2. Turn OFF light level: 3.0 ftc. (Maximum)
3. Turn-off ration: 1.5: 1
4. Operating Voltage: 105 to 305 VAC @ 60 Hz.
5. Control shall remove power from ballast and lamp after detecting 5 lamp cycles per night
6. Control shall reset each dusk. Red flashing LED shall be visible in control window after the control detects HPS lamp cycling.
7. Operating Temperatures: -40 deg C to 70 deg C (-40 deg F to 158 deg F)
8. Moisture Resistance: 98 % RH
9. Maximum Fixture Size: 400 Watt HPS
10. Power consumption: 1.2 watts average
11. Method of Failure: Fail-off
12. Surge Protection: Shall be in the form of a Metal Oxide Varistor (MOV) wired line to neutral. MOV shall be a minimum of 160 Joules.

13. Housing Cover: High impact, UV Stabilized Polypropylene, Black in color.
  14. Housing marking: Year of installation permanently marked, Serial Number, Voltage Range, Loading Rate to be clearly indicated.
  15. Guarantee: 3 years for defective materials or workmanship.
- h. Electronic Button Type Photo Control**
1. Photoelectric control must meet or exceed all requirements of proposed ANSI C136.24.
  2. Line voltage operating range: 105-130 VAC @ 60 Hz.
  3. Turn ON: Calibrate at  $1.5 \pm 0.5$  ft. Turn OFF: Maximum turn OFF 3.0 ft.
  4. Photosensor: Cadmium Sulfide cell shall be sealed to prevent moisture and contamination damage.
  5. Failure mode (per ANIS): Control will fail on.
  6. Time delay: Control must have instantaneous "ON" A 5 - 10 seconds "OFF" delay is required.
  7. Surge protection: Shall be in the form of a Metal Oxide Varistor (MOV) wired line to neutral. MOV shall be a minimum of 100 joules.
  8. Calibration: Each unit must be calibrated in production using a photometer whose accuracy is traceable to the NIST. 100% quality control inspection must be performed after calibration and final assembly.
  9. Chatter: contract "chatter" on opening of contacts (turn OFF of photoelectric control) shall not exceed 5 milliseconds.
  10. Housing: Housing of photoelectric control shall be opaque and of an impact and UV resistant material. Impact resistance of greater than 0.5 ft-lbs at -40 deg C is required. Maximum size, excluding nipple, is 2.3" x 1.3" x 1.3".
  11. Drop test: Control must be cable of withstanding a drop of 3 feet to a concrete floor without causing damage to the housing or changing the electric operation.
  12. Nipple: 3/8 - 18 straight pipe thread (NPSM). Length is .80". Two plastic lock nuts and O-ring shall be supplied.
  13. Lead wires: Leads shall be 18" long. #18 AWG stranded, type 1015 rated for 600 volts and 105 deg C. Color code is as follows: Black = line, Red = load, White = neutral.
  14. Markings: The following must appear on the control: month, year of manufacture, individual serial numbers, complete model description, operating voltage rage, load range, and country of origin.
  15. Warranty: 4 years, one for control replacement.

**i. Shorting Cap**

The cap shall fit into a standard Photocell receptacle and be gasketed so as to form a seal to keep rain and snow from entering the receptacle. The cap should prevent a fixed "on" or shorted contact to the luminaire.

**j. Conversion Kits, Sodium Vapor**

The wattage is specified in the contract document.

The kits shall be for 120 Volt operation and must fit into a #14 and #16 casing for 150W kits and #16 casing for the 250W and 400W kits. The kit shall include a completely pre-wired magnetic regulator ballast for 100W thru 150W kits and a High Power Factor Reactor ballast for 250W and 400W kits, with Mogul base lamp socket, terminal block and the necessary brackets for mounting the kits into the casing. The ballast shall be a magnetic regulator type capable of starting the lamp at -30 F. The lamp wattage shall not vary more than 18% over a + 10% voltage spread. The power factor shall not be less than 90%. The crest factor of lamp current shall not exceed 1.7 for +-10% line voltage variation at any lamp voltage form nominal through life for 100W thru 150W kits.

The ballast for the 250W and 400W, lamp wattage for nominal line voltage and nominal voltage the ballast design center will not vary more than 5% from rated lamp watts. . At any lamp voltage, form nominal through life, the lamp wattage regulation spread at that lamp voltage shall not exceed 25% for +-5% line voltage variation. The ballast must reliably start and operate the lamp in ambient temperatures down to -30 F for the rated life of the lamp. Ballast primary current during starting may exceed normal operating current. The lamp current crest factor shall not exceed 1.8 for +-5% line voltage variation at any lamp voltage, from nominal through life. The power factor of the lamp ballast system shall not drop below 90% for +- 10% line voltage variations at any lamp voltage from nominal through life. The ballast shall be capable of starting and operating one 250W (250w Kit) or one 400W (400w kit) watt High Pressure Sodium Vapor lamp from a nominal 120 volt 60 Hz power source within the limits specified by the lamp manufacturer. The ballast, including the starting aid, must protect itself against mogul lamp failure modes. The ballast shall be capable of operation with the lamp in an open-or short circuit-condition for six months without significant loss of ballast life.

**k. Globes**

Globe No. 118

The globe will be a one-piece blow molded high-impact strength polycarbonate. The globe will sit in the No. 16 casing. The neck of the globe will be cut to a height of 7/16" +- 0.060 in order that the set screws of the casing will hold the globe in place. The globe will be shatter proof and ultraviolet stable. It will be stippled, clear glass in appearance with initial 90% light transmission.

### Globe No. 192

The No. 192 globe shall be one piece blow molded high impact strength polycarbonate. The globe shall sit in the No. 14 D.C. Casing. A returnable casing is available to prospective bidders. The globe shall be shatter proof and ultra-violet stabilized. It shall be stippled clear glass in appearance with initial 90% light transmission.

## 2. Sign Lighting

Sign lighting luminaires shall be mercury vapor. A mercury vapor luminaire shall consist of a luminaire housing and refractor/door assembly constructed of die cast aluminum. The refractor shall be a single piece molded thermal shock resistant borosilicate glass convex lens with discrete prism patterns. The refractor shall be permanently sealed to the door assembly with silicone adhesive around its perimeter. The reflector shall be single piece deiform of sheet aluminum alloy 3002 or as approved by the Chief Engineer, processed to Alcoa Class SI alzak finish. Heavy duty mogul lamp holder shall be securely mounted to the reflector with a galvanized steel bracket. The refractor/door assembly shall be nonpermanent sealed to the luminaire housing and reflector assembly with a single piece neoprene gasket to effectively seal the luminaire and locked in place by stainless steel spring-loaded latches. The refractor/door assembly shall open and be held captive by double pivot internally mounted stainless steel hinges, and it shall be removable.

Weep holes shall be provided in the bottom of the housing in the lowest area of the luminaire as normally mounted.

The sign lighting luminaire shall be designed to properly illuminate the sign with the lamp source type and size as specified in the contract documents. The Contractor shall submit for the approval of the Chief Engineer, working drawings showing locations and aiming angles of luminaires with relation to each of the signs of the various sizes.

### 820.04 HOUSING ASSEMBLIES

The housing assemblies shall consist of durable lightweight aluminum alloy. The housings shall be die cast. The die cast aluminum slip fitter for 1-1/2 or 2 inch pipe bracket shall be integral parts of the castings and shall have not more than an 8 inch long nor less than a 5 inch horizontal insertion length on the 2 inch bracket arms and shall be adequately equipped with clamping and leveling devices or a similar mechanism to allow proper clamping and positioning of the luminaires on the bracket arms.

The optical system shall be filtered against entry of insects, rain, dust, and other offending foreign matter.

The lowest part of the luminaires shall be bottom castings of the same material as the housings, hinged and latched to the upper castings. In the closed position, the refractor supported by the casting shall be held against the gasketed reflector so as to form dustproof and weatherproof assemblies. In the open position, the units shall provide for access to the lamps, reflectors, and sockets and for easy adjustments of the mounting cradles and the lamps.

The housing assemblies shall be provided with separate detachable doors to which the ballasts (and starting aids if required) are mounted.

#### **820.05 BALLASTS**

Luminaires shall be provided with integral ballasts of regulator type, high power factor, operating from multiple circuits, and pre-wired to the luminaire assemblies.

#### **820.06 SOCKETS**

Mogul multiple sockets shall be of the standard low voltage design, except the terminals shall be of nickel-plated bronze construction with screw clamp type terminal with friction grips and provide for mounting on the pole side of the luminaries. The sockets shall be adjustable to produce IES specified time distribution with specified lamps and prismatic refractors.

#### **820.07 REFLECTORS**

Internal reflectors shall be precisely contoured and the inner surfaces shall be highly specular to give, with the refractor, optimum light output and control. Reflectors shall be self-aligning, held in position with snap-in fasteners, and shall require no tools for removal or replacement. The silicon rubber formed gaskets shall be so arranged as to insure proper setting of the refractors against the reflectors.

#### **820.08 REFRACTORS**

Refractors shall be pressed clean crystal glass of the borosilicate type to resist breakage due to heat and mechanical stresses, well annealed, and free from imperfection. The sides or beam sections of the refractors shall contain panels of prisms to accept light from the reflector and refract it to the desired beam direction.

The house side of the refractors shall have smooth inside surfaces and shall contain double duty prisms on the outside, consisting of small refracting prisms, superimposed on larger horizontal prisms to refract light back into the street area.

The street end of the refractors shall contain radial prisms on the inside to spread light along the street area, and outside prisms that lie approximately in a plane slanting down between the luminaire and opposite curb line to refract light downward into the street area for improved illumination uniformity and street side shielding.

The bottom sections of the refractors shall contain outside prisms on the back portion to refract downward light in a forward direction under the luminaire into the street area. The forward position of the bottom shall contain "exploding" prisms on the inside that are contoured in segments of circles to refract light out in all directions that would normally go directly beneath the luminaire, in order to reduce excess light under the luminaire.

Refractors shall be clearly embossed with the designation "street side." They shall be so contoured and of sufficient thickness to resist malicious breakage. Refractors shall have a minimum volume of 520 cubic inches.

**820.09 JUNCTION BOXES AND COVERS**

Junction boxes and covers shall be hot-dipped galvanized in accordance with AASHTO M 111. Junction boxes shall be NEMA Type 4 of the size specified, shall be UL approved, and shall be watertight. Conduit entrances shall be provided with threaded bosses. A neoprene gasket shall be cemented to the cover. Boxes shall be cast iron unless otherwise specified on the contract plans.

**820.10 GROUND RODS**

Ground rods shall be of copper encased steel, 15 feet long, and unless otherwise noted on the plans, 3/4 inch in diameter. Extensions shall be 10 feet in length.

**820.11 WIRES**

All wires used shall bear the UL label. All single conductor cable shall be provided with permanent identification on the outer protective covering, showing size, type, style, and voltage. Unless specified otherwise in the contract documents, wires shall conform to the following:

- (A) Wires for street lighting system and general wiring shall be minimum size No. 10 AWG, 600 volts, copper conductor, Class B Standard, Type THWN, meeting the requirements of latest publications of IPCEA Standard S-61-402.
- (B) Wire used for service and feeder shall be Type XHHW, copper, Class B stranded.
- (C) Wires used for vehicle detector loops shall be Type XHHN, copper, Class B Stranded.
- (D) Wire used for grounding shall be bare or insulated, copper, soft drawn, stranded, sized as noted on the plans, and shall conform to ASTM B 33 or ASTM B 189. Stranded wire shall conform to ASTM B 8.
- (E) Wire Color Code

<u>120/208 Volt</u>	<u>Color</u>	<u>277/480 Volt</u>	<u>Color</u>
Phase A	Black	Phase A	Yellow
Phase B	Red	Phase B	Brown
Phase C	Blue	Phase C	Orange
Neutral	White	Neutral	White
Ground	Green		
Switch Leg	Purple		

**820.12 ELECTRICAL CONDUIT**

Conduit and fittings specified in the Special Provisions and where shown on the plans shall conform to the following:

**(A) METALLIC CONDUIT.**

- (1) Hot-dip galvanized steel conduit shall conform to the requirements of ASTM A 53, UL 6 and FS WW-C-581E, be rigid, and bear the UL label.

- (2) Zinc-coated steel conduit shall conform to the requirements of UL 6 and FS WW-C-581E and bear the UL label, and shall be rigid.
- (3) Plastic coated galvanized steel conduit shall conform to the requirements of UL 6 or ASTM A 53, be rigid and hot-dip galvanized, including threads and have a PVC plastic coating of at least 40 mils in thickness, intimately bonded to the outer galvanized surface. The threads and the interior surface shall be bonded with urethane coating.
- (4) Corrosion resistant steel conduit shall conform to ASTM A 333, Grade 9, except that the chemical requirements are amended to read phosphorous, maximum .095 percent.
- (5) Aluminum conduit shall conform to the requirements of UL 6 and bear the UL label.

**(B) NON-METALLIC CONDUIT.**

- (1) Heavy wall PVC conduit, Type II or Schedule 40, shall conform to Federal Specification 1094A and UL 651, and bear UL label.
- (2) High density polyethylene conduit, Type III, shall conform to UL 651 and bear the UL label.

**(C) BITUMINOUS-FIBER CONDUIT.** Bituminous fiber conduit, Type II, shall conform to FS W-C-581 or W-C 575.

**(D) FIBERGLASS REINFORCED EPOXY CONDUIT.** FRE conduit shall be heavy wall type and conform to NEMA TC-14 and bear the UL label.

### **820.13 CONDUIT EXPANSION AND DEFLECTION FITTINGS**

The conduit expansion and deflection fitting shall be designed to compensate for 3/4 inch movement in any direction between two steel conduits and an angular movement of thirty degrees. The end coupling shall be bronze, and the sleeve shall be neoprene with internal copper bonding jumper.

Conduit expansion fittings shall be provided with a 4 inch minimum free length expansion chamber. This metal fitting shall be provided with an internal bonding assembly and external bonding jumper assembly approved by Underwriter's Laboratories, Inc. The body shall be malleable iron, hot dip galvanized, and the expansion head shall be bronze.

### **820.14 CIRCUIT IDENTIFICATION MATERIALS**

Tags to be used as specified shall be circular in shape, 1-5/8 inch minimum diameter, 0.031 inch minimum thickness, copper, plastic, brass, or fiber tags except that tags within switch and device cabinets shall be of nonmetallic material. Identifying bands shall be approximately 1/32 inch thick, 3/16 inch wide, and 4 inch minimum length nylon, self-clinching type with adequate sized tab for labeling. Tags shall be permanently fastened to cables by means of tying straps of the same material and dimensions as identifying bands without tabs. Each tag or band tab shall be marked using 1/4 inch minimum lettering dies, engraving device or other equivalent permanent marking process. Markings shall indicate "GRD" for all ground and grounded neutral conductors. Companion circuit conductors shall be marked "CKT" followed by the designated letter, numeral, or symbol as may be shown on the plans.

**821 LINE STRIPING MATERIAL**

**821.01 GENERAL**

The Contractor shall notify the District of the name, address, telephone number, and personal representative of the materials manufacturer(s) for materials supplied in accordance with this specification. Materials shall be sampled at the location of manufacture before their shipment. Conformance with the specifications will include the evaluation of test data of the material from a test bed of the AASHTO National Transportation Product Evaluation Program (NTPEP). A certification from the manufacturer shall be submitted to the District, at time of materials delivery, which contains test results of materials delivered, that they conform to these specification requirements, and the date of manufacture and lot or batch number(s) of material delivered. Marking material supplied for applications on project roadways shall be the identical composition as the materials submitted for testing. The material may be provided in either granular or block form, whichever is specified. Furnishing the certification does not relieve the Contractor of responsibility to furnish material in full compliance with this specification. The line striping materials shall be lead free and for the limits on VOCs within the restrictions of use as required by the Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1 or current amendment to the CFR.

**821.02 HOT EXTRUDED LEAD FREE THERMOPLASTIC COMPOUND**

(A) White and yellow alkyd thermoplastic striping material shall conform to the requirements of AASHTO M 249, and these specifications. The total of lead, cadmium and hexavalent chromium is restricted and shall not exceed 100 ppm when tested by X-Ray Fluorescence, ICP, or comparable method capable of this level of detection. Diarylde type pigments shall only be used when the manufacturer or pavement marking material application temperature does not exceed 392 F.

**(B) COMPOSITION**

COMPONENT	TEST METHOD	COLOR	
		WHITE	YELLOW
Binder, % min	Certified	18.0	18.0
Premixed Reflective Beads, % min	AASHTO T250	30.0	30.0
Titanium Dioxide, % min	X-Ray Fluorescence	10.0	–
Calcium Carbonate Inert fillers, % max	D 34	42.0	–
Yellow Pigment, %	–	–	–

Note: Amount of yellow pigment, calcium carbonate and filler shall be at the option of the manufacturer, provided all other requirements are in conformance.

1. **Binders.** The binder shall be alkyd consisting of maleic modified glycerolester of resin and other plasticisers.
2. **Titanium Dioxide.** The titanium dioxide shall be rutile type.

**(C) PROPERTIES**

**1. Physical Properties.**

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Bond Strength, psi min.	AASHTO T250	180
Cracking Resistance		No Cracks
Softening Point, F	ASTM D36	215 ± 15

2. **Specific Gravity.** The specific gravity of the white and yellow pavement marking material shall be 1.7 to 2.2 when tested in conformance with D 153, Method A at 77 F.
3. **Color.** After heating for 4 ± 0.5 hours at 425 ± 3 F, the thermoplastic shall be as specified in ASTM E 1347 and the following:
  - (a) **Production.** The color of the cured thermoplastic material film of the production sample shall match the Federal Standard 595 Color chips specified when compared by instrumental measurement.
  - (b) **Control.** Control color matching determinations will be made using a Pacific Scientific Color Machine, and an observation angle of 2°, and the CIE Chromaticity Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the cured thermoplastic film sample:

	WHITE Color No. 17886		YELLOW Color No. 13538	
	X	Y	X	Y
Standard Chip	0.310	0.330	0.480	0.450
Delta Tolerance	± 0.020	± 0.020	± 0.030	± 0.030

**(c) Reflectance.**

COLOR	TEST METHOD	DAYLIGHT REFLECTANCE at Degree	PERCENT MIN
White	Fed Std 595 No. 17886	45 - 0	80
Yellow	Fed Std 595 No. 13538	45 - 0	50

**(d) Yellowing Index.** The yellowing index of the white material shall not exceed 8 prior to QUV and 15 after QUV when tested in accordance with ASTM E 313.

Glass beads for use with thermoplastic striping materials shall conform to 821.10(A).

**821.03 EPOXY LINE STRIPING MATERIAL**

**(A) GENERAL.** The white and yellow lead free epoxy pavement marking material shall consist of a 100 percent solid two-part system with glass beads embedded homogeneously throughout the depth of the film and the surface. All of these materials shall be lead free as defined herein.

Materials shall be supplied in block form.

**(B) EPOXY COMPONENTS.**

**(a) Composition.**

COMPONENT A	PERCENT BY WEIGHT	
	WHITE	YELLOW
Epoxy Resin	75 - 82	75 - 79
Titanium Dioxide	18 - 25	14 - 17
Organic Yellow	—	7 - 8

The entirety of the pigment of Component A white shall consist of D 476, Type II Rutile Titanium Dioxide. No extender pigments are permitted. Yellow pigments and tinting colors shall be added in proportions which will produce a color equal to the yellow color depicted in the color box described herein. Any Titanium Dioxide used shall conform to D 476, Type II Rutile.

The epoxy system shall contain no volatile solvents. The cured film shall be no less than 99.5 percent of the wet film thickness of the panel at the time it was prepared for test.

**Restrictions.** The manufacturer shall certify that the combined total of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 ppm when tested by X-ray diffraction, ICP, Atomic Absorption Spectroscopy, or a comparable method capable of this level of detection.

- (b) **Epoxide Number.** The weight per epoxy equivalent (WPE) as determined by D 1652 for both white and yellow of Component A, on a pigment free basis, shall conform to a target value  $\pm 50$  provided by the manufacturer and approved by the Chief Engineer.
- (c) **Amine Number.** The amine value of the curing agent (component B) shall consist entirely of stable amines and shall be determined as specified in D 2074. The total amine value shall conform to a target value  $\pm 50$  provided by the manufacturer and approved by the Chief Engineer.

### (C) MIXED COMPOSITION

- (a) **Mixing Ratio.** The mixing ratio for the epoxy pavement marking material shall be proportioned according to the manufacturer's recommendations. The ratio shall not vary more than 2.5 percent during any operation conducted in conjunction with these materials.
- (b) **Color (White and Yellow).**
  - (1) **Production.** The color of the cured epoxy material film of the production sample shall essentially match the specified color chips conforming to Federal Standard 595 when visually compared or by instrumental measurement.
  - (2) **Control.** Control color matching determinations will be made using a Pacific Scientific Color Machine at an observation angle of 2 degrees, and the C.I.E. Chromatically Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the cured epoxy film sample:

	WHITE Color No. 17886		YELLOW Color No. 13538	
	X	Y	X	Y
Standard Chip	0.310	0.330	0.480	0.450
Delta Tolerance	$\pm 0.020$	$\pm 0.020$	$\pm 0.030$	$\pm 0.030$

- (c) **Yellowing Index.** After curing for 72 hours, the yellowing index of the white material when tested in conformance with E 313, using the C.I.E. Scale Illuminate C and 45/2 degrees geometry, shall not exceed 8.0 preceding QUV, and shall not exceed 15.0 after 72 hours in QUV.
- (d) **Toxicity.** After heating to the application temperature, the material shall not exude fumes which are toxic or injurious to persons or property.

- (e) **Directional Reflectance.** The directional reflectance when tested in conformance with E 1347 after QUV using the C.I.E. Scale Illuminate C and 45/2 degrees geometry, shall be minimums of 80 for white and 50 for yellow.
- (f) **Abrasion Resistance.** Abrasion Resistance of the mixed material without glass beads shall be 80 mg maximum loss when tested as specified in C 501 with a 1000 g load, 1000 cycles, CS-17 wheel and a  $15 \pm 0.5$  mil wet film thickness on a S-16 plain steel plate.

**Hardness.** The Type D Durometer Hardness of the material shall be a minimum of 75 when tested in conformance with D 2240. Test films shall be cast on a suitable substrate at

$20 \pm 1$  mil wet film thickness. The film shall be cured 24 to 72 hours at  $75 \pm 2$  F prior to testing.

- (h) **Tensile Strength.** The average tensile strength shall be a minimum of 6000 psi when tested in conformance with D 638, Type IV molded specimens. Specimens shall be cured 24 to 72 hours at  $75 \pm 2$  F with a relative humidity of  $50 \pm 3$  percent prior to testing.
- (i) **Compressive Strength.** The compressive strength of the catalyzed epoxy marking material shall be a minimum of 12 000 psi when tested in conformance with D 695. The test specimen shall be cured 72 hours at  $75 \pm 2$  F with a relative humidity of  $50 \pm 3$  percent prior to testing.
- (j) **Adhesion to Concrete.** The catalyzed epoxy paint pavement marking materials, when tested in conformance with ACI Method 503, shall have a 4000 psi minimum adhesion to the specified concrete surface with 100 percent concrete failure in the performance of this test. The prepared specimens shall be conditioned for 24 to 72 hours at  $75 \pm 2$  F prior to the performance of the tests.
- (k) **Infrared Spectroscopy.** Both component A and component B shall be analyzed to verify for control purposes that materials submitted for use are of an identical formulation as originally approved. Deviations as determined by comparison with the original sample shall be cause for rejection.
- (l) **Curing.** The epoxy material shall be fully cured at a surface temperature of 35 F or above. The pavement marking material shall exhibit a no-tracking time of less than 10 minutes, when mixed in the proper ratio and applied at  $20 \pm 1.0$  mil film thickness at  $75 \pm 2$  F and with the proper saturation of beads when tested in conformance with D 711. The manufacturer shall furnish a table depicting typical no-track time versus various temperatures in the recommended application temperature range.

#### 821.04 TRAFFIC PAINT

- (A) **DESCRIPTION** White and yellow paint material shall be a fast drying water based, nonleaded, acrylic resin paint suitable for use on both asphalt and portland cement concrete surfaces. The paint shall not contain any hazardous material listed in the

Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1.

**(B) PROPERTIES**

1. **Hiding Power:** Paint shall show a dry hiding quality that will give a contrast ratio of at least 0.96 at 0.38 mm (15 mil) wet film thickness.
2. **Settling Properties:** Settling shall be no less than a rating of 8 when tested in accordance with ASTM D869.
3. **Freeze-Thaw and Heat Stability:** Paint shall show no coagulation or change in viscosity greater than +/- 5 KU.
4. **Water Resistance:** Paint shall show no blistering, peeling or wrinkling, softening or loss of adhesion.
5. **VOC: The Volatile Organic Compound** content shall be no greater than 150 grams/liter when tested in accordance with EPA Method 24.
6. **Flash Point:** Paint shall have a flash point of at least 140 degrees F when tested in accordance with ASTM D93, Pensky-Martens Closed Cup.
7. **No-Track Time:** Paint shall have a 60-second maximum vehicle no-track time when measured in accordance with the NTPEP Field Test Procedures.
8. **Maintained Retroreflectivity and Durability:** Maintained retroreflectivity and durability shall conform to the following requirements after being installed on the test deck for 1 year:
  - (a). **Maintained Retroreflectivity:** Photometric quantity to be measured is coefficient of retroreflected luminance (RL) in accordance with the requirements of ASTM E 1743 for 15 meter geometry and ASTM E1710 for 30 meter geometry. RL shall be expressed in millicandelas per square foot per foot-candle and shall be at least either 150 for 15 meter or 100 for 30 meter when measured in the skip line or centerline areas.
  - (b). **Durability:** Paint shall have a durability rating of at least 4 when determined in the wheel path area.
9. **Flexibility.** The pigmented binder shall not display cracking or flaking when subjected to the flexibility test of TT-P-85, with the exception that the panels shall be 35 to 31 gauge (0.0078 to 0.0112 in.) tin plate approximately 3 x 6 in. The tin plates shall be lightly buffed with steel wool and thoroughly cleaned with solvent and dried before being used for the test.
10. **Total Solids.** Total solids shall be a minimum of 70 percent by weight when tested in conformance with Federal Test Method 4041.1, Volatile and Nonvolatile Content (ordinary lab oven).
11. **Weight/Gallon.** The paint shall be 12.0 pounds/gallon minimum and be within 0.2 pounds/gallon of the original qualification sample approved hereunder.
12. **Viscosity.** Viscosity shall be  $80 \pm 10$  KU when tested in conformance with D 562 at 77°F.

**13. Dry Opacity.** Dry opacity shall have a minimum contrast ratio of 0.98 when tested in conformance with Federal Test Method 4121, Procedure B using a 0.015 in. Bird Applicator or 0.030 Doctor Blade.

**14. Color.**

(a) **Production.** The color of the dry paint film of the production sample shall essentially match Federal Standard 595, color chips Nos. 37886 (white) or 33538 (yellow), when compared instrumentally.

(b) **Control.** Control sample color matching determinations will be made using a color machine and the C.I.E. Chromaticity Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the dry paint film sample:

	WHITE Color No. 37886		YELLOW Color No. 33538	
	X	Y	X	Y
Standard Chip	0.32	0.33	0.49	0.44
Delta Tolerance	± 0.02	± 0.02	± 0.03	± 0.03

**15. Glass Bead Adhesion.** The paint with drop-on type beads, applied at the rate of six pounds-per- gallon of binder shall require not less than 550 liters of sand for removal of the beaded film. The test for bead adhesion shall be conducted in accordance with the Abrasion Resistance Test (10 above) and differing therefrom only in that the glass spheres shall be uniformly applied by gravity flow so as to obtain six pounds glass spheres per gallon of binder. The application of the glass spheres is to be a separate operation, but applied at the same time as the paint. Glass beads shall conform to 821.10.

**16. Field Application.** The paint shall not be applied at surface temperatures and air temperatures under 60°F.

**821.05 POLYESTER LINE STRIPING MATERIAL**

**(A) DESCRIPTION**

Polyester-resin is a two-component pavement marking material suitable for use on portland cement concrete surfaces.

**(B) COMPOSITION**

**Composition (uncatalyzed material):  
Min. Max.**

Pigment 36.0 40.0

Acrylic monomer 8.5

Polyester resin 55.5

**(C) REQUIREMENTS**

1. **Viscosity:** Viscosity (25 degrees C), ASTM D562, shall be 80 to 90 Krebs units.
2. **Weight per gallon:** Weight per gallon shall be at least 11.5 pounds.
3. **Drying time:** The catalyst/resin ratio shall be adjusted by the operator so that the applied line shall dry to a no-tracking condition in 15 minutes or less when applied at an application temperature of 77 degrees F to 100 degrees F, a substrate temperature of at least 60 degrees F, a wet thickness of 15 to 25 mils, and with 10 to 15 pounds of glass beads, conforming to the requirements of Section 234, applied per gallon. No-track time shall be determined by passing over the line with a passenger car or pickup truck at a speed of 25 to 35 miles per hour (mph) in a simulated passing maneuver. A line showing no visual deposition of the material to the pavement surface when viewed from a distance of 50 feet shall be considered as showing "no track" and conforming for time to "no-track".
4. **Catalyst:** The catalytic component of the system shall be commercially available type recommended by the manufacturer of the polyester. The peroxide shall not be exposed to any form of heat, such as direct sunlight, radiators, open flame, or sparks. Heat may cause the organic peroxide to decompose violently or burn if ignited. The peroxide shall not come into contact with easily oxidized metals, such as copper, brass, or mild steel or galvanized steel as this can also initiate a violent reaction.
5. **Weight loss:** Beaded catalyzed material shall not have a weight loss of more than 125 milligrams after 1,000 revolutions when abraded according to Federal Test Method Standard No. 141b, Method 6192, using CS-17 wheels with a 1,000-gram load on each wheel.
6. **Shelf life:** The shelf life of uncatalyzed material shall be at least 6 months when stored in a cool area below 85 degrees F.
7. **Durability and wear resistance:** Material shall be designed to provide a life expectancy of at least 3 years under an average daily traffic count per lane of approximately 9,000 vehicles.
8. **Hiding:** The marking shall show a dry hiding quality that will give a contrast ratio of at least 0.96 with the Merest Black and White Power Chart, Form 03B when drawn down at a fifteen (15) mil wet film thickness. Readings will be determined in accordance with the requirements of ASTM E 1349 using CIE1931 2 degree standard observer and CIE standard Illuminant D65.

**821.06 PERMANENT PREFORMED LINE STRIPING MATERIAL****(A) GENERAL**

The materials shall remain in place on the asphaltic concrete or Portland Cement concrete pavement surfaces without being displaced by traffic, and shall not be affected by weather conditions.

The material shall be of good appearance and free from cracks. Edges shall be true, straight and unbroken. Line marking material shall be in rolls having no more than three

splices per 150 ft of length. All marking materials shall be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year.

**(B) DESCRIPTION**

Permanent preformed pavement marking materials shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and the following:

1. **Composition.** The marking material shall consist of a mixture of polymeric materials, pigment and glass or ceramic beads distributed uniformly throughout the surface. The material, without adhesive, shall be a minimum of 60 mils thick.
2. **Color.** The color of the marking materials shall match Federal Test Standard Number 595 for the following:
  - White - 17886
  - Yellow - 13538
3. **Tensile Strength.** The tensile strength of the material shall be at least 175 psi when tested as specified in D 638 using a 1 x 6 in. specimen.
4. **Elongation.** The elongation of the material at break shall be 15 to 90 percent when tested as specified in D 638 using a 1 x 6 in. specimen.
5. **Flexibility.** When the material is bent 180 degrees around a 1/4 in. mandrel, it shall show no signs of cracking or loss of surface dressing beads.
6. **Skid Resistance.** The British Pendulum Number shall be a minimum of 45 BPN when tested as specified in E 303.
7. **Patchability.** The material shall be capable of patching worn areas of the same material type in accordance with the manufacturer's instructions.
8. **Freeze-thaw.** The adhesive quality of the material will be considered satisfactory if it has a minimum of 65 percent adhesive bond after 100 cycles of freeze-thaw action when tested as specified in C 666, Method B.

**821.07 PERMANENT PREFORMED PATTERNED LINE STRIPING MATERIAL**

**(A) GENERAL**

The material shall be capable of adhering to asphaltic concrete and portland cement concrete surfaces, and to any existing pavement markings in accordance with manufacturer's recommendations by a pre-coated pressure sensitive adhesive. A primer shall be used to precondition the surface if recommended by the manufacturer. The markings shall be capable of being inlaid in new hot mix asphalt surfaces during the paving operation.

The material shall be highly durable and retro-reflective and shall be fabricated of a polymeric material designed for longitudinal and legend/symbol markings subjected to high traffic volumes and severe wear conditions, such as shear action from crossover or encroachment on typical longitudinal configurations, and where high levels of reflectivity are required to ensure the safety of the motoring public.

The material shall be of good appearance and free from cracks. Edges shall be true, straight and unbroken. Line marking material shall be in rolls having no more than three splices per 150 ft of length. All marking materials shall be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year.

The material shall remain in place on the pavement surface without being displaced by traffic, and shall not be affected by weather conditions.

## (B) DESCRIPTION

1. **Composition.** The material shall consist of a mixture of polymeric materials, pigments and reflective spheres distributed throughout the base cross-sectional area and reflective spheres bonded to the topcoat surface to provide immediate and continuing retro-reflection. The marking material may include a black perform patterned film border.
2. **Restrictions.** The combined total of lead, cadmium, mercury and hexavalent chromium shall not exceed 100 ppm. Diarylide based pigments and non-leachable lead pigmentation are not acceptable. The presence of these compounds shall be tested for compliance to the specification by X-ray diffraction, ICP, or another comparable method, capable of this level of detection.
3. **Reflectance.** The manufacturer shall certify that the white and yellow materials shall have the minimum initial retroreflectance values of 350 mcd/L/m<sup>2</sup> for white and 250 mcd/L/m<sup>2</sup> for yellow markings in any 528 ft section. Reflectance shall be measured using a reflectometer with CEN 30-meter geometry (88.76 degree entrance angle and 1.05 degree observation angle).
4. **Color.** The color of preformed markings shall essentially match the 37886, 33538 or 37038 color chips for white, yellow or black respectively as shown in Federal Standard 595A.
5. **Skid Resistance.** The British Pendulum Number shall be a minimum of 45 BPN when tested as specified in E 303.
6. **Thickness.** The material, without adhesive, shall be a minimum of 65 mils thick.

## 821.08 PERMANENT PREFORMED LINE STRIPING MATERIAL – HEAT APPLIED

### (A) GENERAL

The material shall be highly durable retro-reflective polymeric materials designed for use as transverse lines, numbers, legends, symbols and arrow markings subjected to high traffic volumes and severe wear conditions such as shear action from crossover or encroachment.

The applied material shall adhere to asphaltic concrete pavement, portland cement concrete (PCC), and any existing pavement markings when applied using normal heat from a propane fueled heat gun in conformance with manufacturer's recommendations.

The applied material shall be capable of conforming to pavement contours, breaks and faults, shall not be affected by weather conditions, and shall remain in place on pavement surfaces without being displaced by traffic.

The material shall have a minimum shelf life of one year.

**(B) DESCRIPTION**

The material shall conform to the requirements of the MUTCD and the following:

1. **Composition.** The material shall consist of polymeric materials, pigments, binders and glass beads distributed throughout the entire cross-sectional area. The thermoplastic material shall conform to M 249 with the exception of the relevant differences for the material being supplied in the preformed state.
2. **Restrictions.** The combined total of lead, cadmium, mercury and hexavalent chromium shall not exceed 100 ppm when tested by X-ray diffraction, ICP, or comparable method capable of this level of detection. Nonleachable lead based pigments will not be permitted. Diarylide type pigments shall only be used when the manufacture or pavement marking material application temperature does not exceed 392 F.
3. **Color.** Preformed markings shall consist of film with pigments selected and blended to match Federal Standard 595 color chip Nos. 17886 and 13538 for white and yellow respectively.
4. **Skid Resistance.** The surface of the applied material shall provide a minimum average skid resistance value of 50 BPN when tested in conformance with E 303.
5. **Patchability.** The material shall be capable of use for patching worn areas of the same type in conformance with manufacturer's recommendations.
6. **Thickness.** The minimum thickness, without adhesive, shall be 120 mils.
7. **Adhesion.** The material shall retain a minimum of 65 percent adhesive bond after 100 cycles of freeze-thaw when tested in conformance with C 666, Method B.

**821.09 REMOVABLE PREFORMED LINE STRIPING MATERIAL**

**(A) GENERAL**

Removable preformed pavement marking material shall remain in place on the pavement surface without being displaced by traffic or affected by weather conditions. The material shall be capable of being removed without the use of heat, solvents, grinding or sand blasting, and shall not leave an objectionable residue.

The material shall be of good appearance and free from cracks. Edges shall be true, straight and unbroken. Line marking material shall be in rolls having no more than three splices per 150 ft of length. All marking materials shall be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year.

**(B) DESCRIPTION**

White and Yellow. Removable preformed pavement marking materials shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) latest edition and the following:

1. **Composition.** The marking material shall consist of a mixture of polymeric materials, pigment and glass beads distributed uniformly throughout the surface.

2. **Color.** The color of the marking materials shall match Federal Test Standard No. 595A, latest edition for the following:

White - 17778

Yellow - 13538

3. **Glass Beads.** Glass beads shall conform to the General Requirements of M 247.
4. **Skid Resistance.** The British Pendulum Number shall be a minimum of 50 when tested as specified in E 303.
5. **Retro-reflectance.** The marking material shall have the initially the same retro-reflectance values under wet or dry conditions. Retro-reflective Luminance shall be a minimum of 750 for white and 450 for yellow when tested under ASTM D 4061, dry conditions, and ASTM E 2176 and E 2177 for wet conditions.

**Black.** Removable preformed pavement marking materials shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) latest edition and the following:

1. **Composition.** The non-reflective, patterned black line masking tape shall not contain metallic foil and shall consist of a mixture of high quality polymeric materials, pigments and inorganic fillers distributed throughout its base cross-sectional area, with a matte black non-reflective top layer. The patterned surface shall have a minimum of 20 percent of the surface area raised and coated with nonskid particles. The channels between the raised areas shall be substantially free of particles. The film shall be pre-coated with a pressure sensitive adhesive. A nonmetallic medium shall be incorporated to facilitate removal.
2. **Skid Resistance.** The surface of the patterned, non-reflective black line mask shall provide an initial average skid resistance value of 60 BPN when tested in conformance with E 303.
3. **Thickness.** The patterned material, without adhesive, shall have a minimum caliper of 0.065 in. at the thickest portion of the patterned cross-section, and a minimum caliper of 0.02 in. at the thinnest portion of the cross-section.
4. **Adhesion.** The manufacturer shall demonstrate that the properly applied black line mask adheres to the roadway and existing stable roadway markings under climatic and traffic conditions normally encountered in the construction work zone.
5. **Removability.** The manufacturer shall show that the black line mask can be manually removed after its intended use, intact or in large pieces, at temperatures above 40 F without the use of heat, solvents, grinding or sand or water blasting. The black line mask shall remove cleanly from existing markings that are adequately adhered to the pavement surface.
6. **Performance Requirements.** When applied in accordance with the of the manufacturer's recommendations, the black line mask shall provide a neat, durable masking that will not flow or distort due to temperature if the

pavement surface, or underlying markings remain stable. The black line mask shall be weather resistant and, through normal traffic wear, shall show no lifting or shrinkage which will significantly impair the intended usage of the tape throughout its useful life, and shall show no significant tearing or other signs of poor adhesion.

**821.10 GLASS BEADS**

**(A) FOR HOT EXTRUDED THERMOPLASTIC.** Glass beads shall meet the requirements of AASHTO M 247, Type II . Moisture resistance coatings shall be applied.

GRADATION SIEVE SIZE	PERCENT PASSING
	UNIFORM BEADS
0.60 mm (No. 30)	100
0.425 mm (No. 40)	90-100
0.30 mm (No. 50)	50-75
0.18 mm (No. 80)	0 – 5

**(B) FOR EPOXY AND POLYESTER LINE STRIPING.** Glass beads shall be premixed and shall meet the requirements of AASHTO M 247, Type I, Moisture resistance does not apply.

GRADATION SIEVE SIZE	PERCENT PASSING
	UNIFORM BEADS
0.60 mm (No. 30)	100
0.425 mm (No. 40)	90-100
0.30 mm (No. 50)	50-75
0.18 mm (No. 80)	0 – 5

**(C) FOR TRAFFIC PAINT.** Glass beads shall be drop- on and shall meet the requirements of AASHTO M 247, Type I . Moisture resistance coatings shall be applied.

GRADATION SIEVE SIZE	PERCENT PASSING
	STANDARD BEADS
0.85 mm (No. 20)	100
0.60 mm (No. 30)	75-95
0.30 mm (No. 50)	15-35
0.15 mm (No. 100)	0 – 5

Glass beads shall be colorless, clean, transparent, and free of milkiness, excessive air bubbles, and essentially free of sharp angular scarring or scratching. The beads shall be spherical in shape and shall contain a minimum of 60 percent silica. Roundness shall be 75 percent minimum when tested as specified in ASTM D 1155, Procedure A. The glass beads shall have a refractive index of 1.50 when tested by the liquid immersion method (Becke Line Method or equal) at a temperature of  $77 \pm 9^\circ \text{F}$ .

**822 MISCELLANEOUS MATERIALS**

**822.01 WATER**

Water for use in portland cement concrete or mortar shall be free from injurious amounts of oil, acid, alkali, vegetable substance or other deleterious matter and shall be tested in accordance with AASHTO T 26. "Quality of Water To Be Used in Concrete". Use of river and stream water is prohibited. On District contracts, the Water and Sewer Authority representative will issue permits for attachment to public hydrants for the use of water.

**822.02 BEARING PADS**

(A) **PREFORMED FABRIC PADS.** Preformed fabric pads shall be composed of multiple layers of 8-ounce cotton duck impregnated and bound with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the lamination of not less than 10,000 pounds per square inch without detrimental reduction in thickness or extrusion.

(B) **ELASTOMERIC BEARING PADS.** Elastomeric bearing pads less than 1/2 inch in thickness shall be either laminated or all elastomer. Pads 1/2 inch or over in thickness shall be laminated. Stacking of individually laminated pads to attain thicknesses over 1/2 inch will not be permitted; however, cold bonding of individual laminated pads will be permitted providing the bond between the pads has a minimum peel strength of 20 pounds per inch. Laminated pads shall consist of alternate layers of elastomer and metal or fabric reinforcement bonded together. The top and bottom layers of reinforcement shall be uniformly covered with a maximum of 1/8 inch of elastomer. The edges of metal reinforcement shall be fully coated with elastomer not more than 1/4 inch in thickness.

Elastomeric bearing pads, elastomer and reinforcement shall conform to the requirements of AASHTO M 251, except that the elastomer shall show no cracks when subjected to ozone resistance at 20 percent strain for 100 hours 2°F in accordance with ASTM D 1149, except 100 20 parts per 100,000,000 ozone.

(C) **NEOPRENE PADS.** Neoprene pads shall be cast in molds under pressure and heat. Pads shall meet the requirements listed herein. A certification from the manufacturer shall be required that includes test results showing conformance to these specification requirements.

Grade (Durometer)	50	60	70
Original Properties			
Hardness, STM D 676	50 + -5	60 + -5	70 + -5
Min. Tensile Strength, psi,			
ASTM D 412	2500	2500	2500
Min. Elongation at Break, %	400	350	300

573, 70 hrs at 212°F			
Hardness, Max, points change	0 to +15	0 to +15	0 to +15
Max. Tensile Strength Change, %	+/-15		+/-15
Max. Elongation at Break Change, %	-40	-40	-40
1 PPM Ozone in Air by volume at 20 Strain and 100+/-2°F, ASTM	No Cracks	No Cracks	No Cracks
Compression Set for 22 hrs at 158F, ASTM D 395, Method B, Max Percent	25	25	25
Min. Tear, Pounds per linear inch, ASTM D 624, Die C	225	225	225
Laminated	Yes	No	

**822.03 LIME**

- (A) Hydrated lime used as an anti strip additive in bituminous mixtures shall conform to the requirements of AASHTO M 216, Type I, Grade A.
- (B) Lime used in seeding shall consist of an agricultural calcic or dolomitic ground limestone containing at least 85 percent of total calcium and magnesium carbonates. Limestone shall be per standards of the Association of Official Agricultural Chemists and ASTM C 51.

Lime shall meet following sieve analysis: At least 40 percent passing a No. 100 sieve, and at least 95 percent passing a No. 8 sieve.

- (C) Crown vetch lime for agriculture use shall be ground limestone with 90 percent passing a 20 mesh screen and 40-50 percent passing 100 mesh screen. It shall contain a minimum of 85 percent total carbohydrates.
- (D) Hydrated lime used in masonry mortar shall meet the requirements of AASHTO M 216, Type I or II, as specified in the contract documents.
- (E) Hydrated lime for use in masonry mortar for glazed ceramic wall tile shall conform to the requirements of ASTM C207, Type S.

**822.04 PRECAST PCC SEWER-WATER UNITS**

Precast PCC sewer and water manhole and casing units, basin tops with cover, grade rings, drip stones and cheek blocks shall be as per AASHTO M 199.

**822.05 ADAPTER RINGS**

- (A) **CONCRETE.** Concrete for concrete adapter rings shall meet the requirements of PCC mix design as specified in 817. The rings shall be of the size and dimensions as indicated on the plans.
- (B) **CAST IRON.** See 815.04.

**822.06 ANCHOR BOLTS**

- (A) **PAVING.** Anchor bolts shall be 9/16 inch in diameter and at least 11 inches long. The bolt shall be equipped with an expansion device on one end and a hook on the other. The bolts shall meet the requirements of AASHTO M 31, plain bars, Grade 40.
- (B) **MISCELLANEOUS.** Self-anchoring bolts shall be per FSS FF-S-325 for Group I, Type 2, Styles 1 and 2; Group II, Type 4, Class 1 and 2; or Group III, Types 1 and 2. Bolts shall be galvanized per AASHTO M 232 and be capable of withstanding a proof test load 4 times greater than the design working load.

**822.07 MANHOLE STEPS**

Manhole steps shall be reinforced plastic steps composed of ASTM A 615, Grade 60 reinforcing bar (#4) completely encapsulated in copolymer polypropylene per ASTM D 2146, Type II, Grade 43758, as made by M. A. Industries, Inc., Peachtree City, Georgia, Model PSI-B for brick selections and model PSI-PF for concrete riser sections, or approved equivalent reinforced plastic step.

**822.08 EPOXY**

- (A) **GENERAL.** Epoxy for use as a binder with aggregates or for bonding hardened concrete, plastic concrete, wood, metals, masonry, and most plastics shall conform to the requirements of ASTM C 881-90 or AASHTO M 235-91 for the Type, Grade, Class, and color specified. A certificate of compliance shall be required for each epoxy used. Types I and II epoxy shall not be used. This specification shall not be used for bonding surfaces of polyethylene, TFE, fluorocarbon, cellophane, or surfaces which are greased or waxed. The stocometric ratio of epoxy base and hardener shall be by volume and shall not exceed a 4 to 1 ratio.

The following guide shall be used for determining acceptable epoxies for use:

*Type III* - For use in bonding skid-resistant materials to hardened concrete, and as a binder in epoxy mortars or epoxy concretes used on traffic bearing surfaces (or surfaces subject to thermal or mechanical movements).

*Type IV* - For use in load bearing applications for bonding hardened concrete to hardened concrete and other materials and as a binder for epoxy mortars and concretes.

*Type V* - For use in load bearing applications for bonding freshly mixed concrete to hardened concrete.

*Type VI* - For bonding and sealing segmental precast elements with internal tendons and for span-by-span erection when temporary post tensioning is applied.

*Type VII* - For use as a nonstress carrying sealer for segmental precast elements when temporary post tensioning is not applied as in span-by span erection.

*Grade 1 - Low Viscosity:* For use where a fluid epoxy is required for application such as for mixing and penetration.

*Grade 2 - Medium Viscosity:* For use on surfaces not requiring penetration such as bonding new to old concrete.

*Grade 3 - Non-sagging consistency.*

*Class A:* For use on surfaces or with materials below 40° F.

*Class B:* For use on surfaces or with materials between 40° F and 60° F.

*Class C:* For use on surfaces or with materials above 60° F.

**(B) EPOXY ADHESIVE.**

(1) For Bonding New PCC to Existing PCC. Epoxy resin for bonding new PCC to existing PCC shall conform to the requirements of ASTM C 881, Type V, Grade 1 or 2, Class B and C.

(2) For Embedment of Dowels and Anchor Bolts in Drilled Holes in Existing PCC.

(a) In cases where drilled holes are positioned such that the liquid epoxy material will not run out, epoxy resin adhesive for embedment of dowels and anchor bolts in drilled holes in existing PCC shall conform to the requirements of ASTM C 881, Type IV, Grade 1 or 2, Class B and C.

(b) In cases where drilled holes are positioned such that the liquid epoxy material would run out, epoxy resin adhesive for embedment of dowels and anchor bolts in drilled holes in existing PCC shall conform to the requirements of ASTM C 881, Type IV, Grade 3, Class B and C.

(3) For Repair of Cracks by Injection of Epoxy Resin Adhesive.

(a) Epoxy resin adhesive for surface sealing cracks prior to epoxy injection shall conform to the requirements of ASTM C 881, Type IV, Grade 3, Class B and C.

(b) Epoxy resin adhesive for epoxy injection into cracks shall conform to the requirements of ASTM C 881, Type IV, Grade 1, Class B and C.

**(C) EPOXY MORTAR** Epoxy resin adhesive for preparing epoxy mortar shall conform to the requirements of ASTM C 881, Type IV, Grade 1, Class B and C. Fine aggregate for epoxy mortar shall conform to 803.06.

Pourable epoxy mortar shall consist of one part epoxy resin adhesive and one part by volume dry fine aggregate; trowelable epoxy mortar shall consist of one part epoxy resin adhesive and three parts by volume dry fine aggregate.

**(D) CERTIFICATION** The manufacturer shall certify that epoxy resin adhesive meets the requirements of this specification. Certification shall consist of a copy of the manufacturer's test results and a statement by the manufacturer that the material

represented by lot or batch number has been sampled and tested, meeting the requirements of this specification. The statement shall indicate the date of testing and shall be signed by an authorized agent of the manufacturer of formulator.

**822.09 GEOTEXTILE FABRICS AND MEMBRANES**

Geotextile fabrics used for subsurface drainage, sub-grade stabilization, erosion control, sediment control and as a permeable separator, including filter fabric, shall meet the materials and certification requirements of AASHTO M 288. Fabric used for subsurface drainage shall be of the non-woven type with a minimum flow rate of 0.1 gallon per square foot per minute and minimum tensile strength (20 percent elongation) of 25 lbs./linear inch for standard strength and 50 lbs. per linear inch for extra strength.

**TABLE GEOTEXTILE FABRICS**

District Of Columbia Application Class	Type Of Geotextile	Grab Strength Lb D 4632	Puncture Strength Lb D 4633	Permittivity Sec-1 D 4491	Apparent Opening Size, Max Mm D 4751	Trapezoid Tear Strength Lb D 4533
SD TYPE I	Nonwoven	160	56	0.50	0.43	55
	Woven, Monofilament	250	90	0.50	.043	90
SD TYPE II	Nonwoven	160	56	0.20	0.25	55
	Woven, Monofilament	250	90	0.20	0.25	90
PE TYPE I	Nonwoven	200	80	0.70	.043	80
	Woven, Monofilament	250	90	0.70	.043	90
PE TYPE II	Nonwoven	200	80	0.20	0.25	80
	Woven, Monofilament	250	90	0.20	0.25	90
PE TYPE III	Nonwoven	200	80	0.10	0.22	80
	Woven, Monofilament	250	90	0.10	0.22	90
SE	Nonwoven	200	80	0.20	0.30	80
	Woven	250	90	0.20	0.30	90
ST	Woven	300*	110	0.05	0.15**	110
F	Woven	100	-	0.05	0.60	-
E	Nonwoven	90	30	.050	0.30	30

Note 1: All property values are based on minimum average roll values in the weakest principle direction, except for apparent opening size.

Note 2: The ultraviolet stability shall be 50 percent after 500 hours of exposure for all classes, except Class F, which shall be 70 percent (D 4355).

\*Minimum 15 percent elongation. \*\*This is a MINIMUM apparent opening size, not a maximum.

The properties shall be determined in accordance with the following procedures:

- Apparent opening size           ASTM D-4751
- Grab tensile strength           ASTM D 4632: 4x8" specimen, 1x2" clamps, 12"/min. strain rate in both principal directions of geotextile fabric.
- Puncture Strength               ASTM D 4833

The fabric shall be insert to commonly encountered chemicals and hydrocarbons, and will be rot and mildew resistant. It shall be manufactured from fibers consisting of long chain synthetic polymers, and composed of a minimum of 85% by weight of polyolephins, polyesters, or polyamides. The geotextile fabric shall resist deterioration from ultraviolet exposure.

In addition, Classes A through E shall have a 0.01 cm./sec. minimum permeability when tested in accordance with ASTM D-4491, and an apparent minimum elongation of 20 percent (20%) when tested in accordance with the grab tensile strength requirements listed above.

#### Silt Fence

Class F geotextile fabrics for silt fence shall have a 50 lb./in. minimum tensile strength and a 20 lb./in. minimum tensile modules when tested in accordance with ASTM D-4595. The material shall also have a 0.3 gal. square ft. min. flow rate and seventy-five percent (75%) minimum filtering efficiency when tested in accordance with ASTM D-5141.

Geotextile fabrics used in the construction of silt fence shall resist deterioration from ultraviolet exposure. The fabric shall contain sufficient amounts of ultraviolet ray inhibitors and stabilizers to provide a minimum of 12 months of expected usable construction life at a temperature range of 0 to 120 degrees f.

### **822.10 DAMPPROOFING AND WATERPROOFING MEMBRANE**

The adhesive side of the membrane shall be protected with a special release paper that can easily be removed for installation. The membrane shall conform to the following requirements:

<b>Test Property</b>	<b>Test Method</b>	<b>Specification Limits</b>
Grab Tensile Strength, lb/in @ 12 in/minute rate of loading, min	D5034	70
Pliability, 180° bend, 1 in. Mandrel @ 20° F	D 146	unaffected
Resistance to Puncture, lb min	E 154 (square mounting frame method)	40
Permeance, perm (kg/Pa*s*m <sup>2</sup> ), Max	E 96 Method D	0.1
Weight, oz/yd <sup>2</sup> min	D3776	40
Primer	--	as specified by the manufacturer

Roll and sheet waterproofing membrane may be accepted on certification. The manufacturer shall furnish certification. With actual test results showing that the material conforms to these specifications.

**822.11 LOOP SEALANT**

The loop slot sealant shall be a one-component, moisture-curing, flexible polyurethane, formulated to encapsulate loop wires embedded in asphaltic cement and portland cement concrete pavements. The sealant shall remain flexible at all temperatures of -40°F and higher to protect the wire or cable from the stress of pavement movement. The flow characteristics of the sealant shall allow full depth wire encapsulation and resist flow-out on inclined roadways. Application equipment shall be capable of filling slots from the bottom up.

The sealant shall permit the roadway to be opened to traffic over the slot immediately after application without tracking, sticking to vehicle tires, or pulling out of the slot. The cured sealant shall have the following performance characteristics when tests are conducted on de-aerated, 20 mil (0.020 inch) thick, dry film liquid immersion, after curing for 28 days at 77° F.

Description	Specification Limits	Test and Conditions
Hardness (Indentation) 50% relative humidity.	65- 85 Model 1770, @ 77° F and	ASTM D2240 Rex, Type A,
Tensile Strength	500 psi, (minimum)	ASTM D412 Die C, pulled at 20 fpm.
Elongation (minimum)	400%, at 20 fpm.	ASTM D412 Die C, pulled
Flex  mandrel.	No Cracks at -40° F	25 Mil Free Film Bend (180 degrees) over 1/2 inch
Weathering Resistance	Slight Chalking	ASTM D8122 Weatherometer, 350 hours. Cured 7 days @ 77° F and 50 percent relative humidity.

**822.12 WOOD**

Unless otherwise specified wood and wood products shall meet the specification requirements of AASHTO M 168 for the grading and classification required.

- (A) WOOD FOR PERMANENT TYPE WOODEN BARRICADE.** Posts and rails shall be of the dimensions shown on the plans and shall be finished lumber, either dense southern pine or dense douglas fir of minimum stress grade 1400 psi.
- (B) WOOD FOR PARK TYPE WOODEN GUARDRAIL .** The timber for rails and posts shall be dense southern pine or dense douglas fir, of minimum stress grade 1400 psi,

rough sawn with scantness not exceeding 1/2 inch in any dimension, and pressure treated. No boxed heart pieces shall be allowed for posts and rails of douglas fir. Boxed heart pieces are defined as timber so sawed that at any point in the length of a sawed piece the pith lies entirely within the four faces. The timber shall be air seasoned or artificially seasoned until the amount of moisture in the wood will not prevent the adequate penetration and retention of the specified amount of preservative.

Pressure treatment shall be per 811.08(A).

- (C) **WOOD FOR TIMBER GROUND MOUNT SIGN POSTS.** Timber posts shall consist of douglas fir or southern yellow pine, coast region, select structural grade, or approved equivalent, meeting requirements of AASHTO M 168, seasoned, treated, and painted in conformance with plans and these specifications. Grading shall strictly meet requirements of the Western Pine Association, except that boxed-heart wood will not be permitted.

Preservative for treatment shall be per 811.08(C).

- (D) **WOOD FOR TREE SUPPORT STAKES.** Stakes for tree support, bracing, and dead men shall be rough cypress, cedar, locust or other approved wood, free from unsound and loose knots, rot, cross grain, or other defects that may impair strength of stake. All portions of wood stakes in contact with, or under, the ground shall be treated with an approved preservative. Exposed portions of wood stakes shall be stained an approved green color. Cedar stakes shall be round with bark intact; stain or preservative is not required.

### 822.13 RAISED REFLECTIVE DELINEATORS

- (A) **PAVEMENT DELINEATORS.** Pavement delineators shall be raised, single or double faced, either direction plowable and all-weather reflective. Delineators shall consist of a replaceable prismatic retro-reflector set in a steel protective saddle encased in concrete. The delineator shall be fastened to the road surface with an epoxy adhesive compound recommended by the delineator manufacturer.

- (1) **CASTING.** The casting shall weigh not more than 4 pounds and its overall dimensions shall be approximately 8 inches long by 6 inches wide by 2 inches high. It shall be shaped to deflect the blade of a snowplow driven from either direction. The surface of the casting shall be free of scale, oil, dirt, or any contaminant which might reduce the bond to the pavement materials. Casting shall be marked with manufacturer's name and model number.

The steel protective saddle for the reflector shall be of abrasive resistant steel plate, AR 360 or AR 380. The crossbar shall be of 1 inch by 0.125 inch stock, and the longitudinal bars shall be at 1 inch by 0.375 inch stock.

The concrete shall consist of 1 bag of Type III Portland cement, 4 bags of Taggart Special sand, 3 gallons of water, one fluid ounce of air entraining admixture, and 15 fluid ounces of Mighty 150 Superplasticizer. This mixture will make 63 units. The concrete shall be mixed for 3 minutes minimum and vibrated for not less than 5 seconds.

**(2) REFLECTORS.**

- (a) **Design and Fabrication.** Reflectors shall consist of an acrylic plastic shell filled with tightly adherent potting compound. The shell shall contain one prismatic reflective face as required to reflect incident light from a single direction. The outer surface of the shell shall be smooth except for purposes of identification.

The reflector shall be in the shape of a shallow frustrum of a pyramid. The bottom of the reflector shall be equipped with pressure-sensitive adhesive to permit its attachment to the primed surface of the casting. Dimensions of the reflector shall be 4 x 2 x .460 inches. The slope of the reflecting surface shall be 30 degrees and the area of the reflecting surface shall be 1.7 square inches.

- (b) **Materials.** The shell shall be molded of methyl methacrylate conforming to FS L-P-380A, Type 1, Class 3. Filler shall be a potting compound selected for strength, resilience, and adhesion adequate to pass the necessary physical requirements.

The adhesive shall be pressure-sensitive, 100 percent solid, .040 inch thick with closed cell release paper on the bottom. Pressure-sensitive adhesive shall possess adhesion and physical qualities necessary to pass test requirements as specified in 822.13(A) (3) (c).

- (c) **Physical Requirements and Testing for Reflectors.** From the delineators supplied a random sample of 10 shall be selected. A reflector shall be placed top side up on a steel plate not less than 1/2 inch thick. The load to the top of the delineator shall be applied slowly through a 1 inch diameter, one 1 inch high metal plug, centered on top of the delineator.

Breakage or deformation of the delineator at any load less than 2000 pounds shall constitute failure of the delineator. Failure of more than six of the delineators shall be cause for rejection of the lot.

- (d) **Optical Requirements.**

(i) **Definitions.**

Horizontal Entrance Angle - The angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the reflector.

Observation Angle - The angle at the reflector between observer's line of sight and the direction of the light incident to the reflector.

Specific Intensity (S.I.) - The candlepower, in foot-candles, of the returned light at the chosen observation and entrance angle for each foot candle of illumination at the reflector on a plane perpendicular to the incident light.

**(ii) Optical Performance.**

Steel Wool Abrasion Procedure - Form a 1 inch diameter flat pad using #3 coarse steel wool per FS FF- W-1825. Place the steel wool pad on the reflector lens. Apply a load of 50 pounds and rub the entire lens surface 100 times.

Specific Intensity - After abrading the lens surface, using the above steel wool abrasion procedure, the specific intensity of each crystal reflecting surface at 0.2 degrees observation angle shall not be less than the following, when the incident light is parallel to the base of the reflector:

<b>HORIZONTAL ENTRANCE ANGLE</b>	<b>S.I.</b>
0 degrees	3.0
20 degrees	1.2

For yellow reflectors, the specific intensity shall be 60 percent of the value for clear crystal.

**(iii) Optical Testing Procedure.** A random lot of 10 reflectors shall be tested. The reflector to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inches.

The photocell width shall be an annular ring .37 inch I.D., or .47 inch O.D. It shall be shielded to eliminate stray light. The distance from light source center to the photocell center shall be 0.21 inches. If a test distance of other than 5 feet is used, the source and receiver dimensions and the distance between source and receiver shall be modified in the same proportion as the test distance.

Failure of more than 6 of the reflecting faces tested shall be cause for rejection of the lot.

**(3) REFLECTOR BONDING.** Fastening shall be accomplished by bonding the reflector to the casting through use of the pressure-sensitive tape permanently adhered to the reflector. Bonding shall be done at ambient temperatures of 50° F (10° C) or higher.

**(a) Casting Preparation.** Clean casting in reflector pad area. Apply a thin coat of primer to clean, dry area and allow it to dry.

**(b) Bonding Reflector.** Remove the reflector release paper from the bottom of the reflector and place the reflector on the casting with the proper lens facing traffic. Apply a load of 1,000 pounds to 2,500 pounds for 3 seconds minimum.

**(c) Pressure-Sensitive Adhesive.**

**(i) Strength Requirements.** Pressure-sensitive adhesive, when applied with minimum application pressure of 60 psi must possess a minimum tensile or shear strength of 15 psi at 70° F (21° C) ambient temperature.

- (ii) **Strength Testing Procedure.** A standard 4 x 2 x .46 inch reflector with pressure-sensitive adhesive on the bottom shall be adhered to appropriate flat 12 inch carbon steel test plate, properly primed, with 60 psi minimum application pressure. Both the top of the reflector and the bottom of the flat plate shall have fastened to it an appropriate coupling device to ensure compatibility with the tensile testing device. The test sample shall be tested in the tensile mode at 2"/minute pull rate. Minimum load to produce failure shall be 125 pounds at 70° F (21° C). Any figure below 125 pounds constitutes system failure.

**(d) Primer.**

- (i) **Strength Requirements.** The primer shall provide for the proper surface condition to promote optimum adhesion between the substrate and pressure-sensitive adhesive.
- (ii) **Strength Testing Procedures.** Prime test plate with primer and allow to dry. Apply pressure-sensitive adhesive between primed test plates with 60 psi application pressure. The primer shall be judged as acceptable if after subjecting specimen to tensile loading at 70° F (21° C) ambient, the failure is cohesive.

- (B) BARRIER DELINEATORS.** The delineator shall consist of an ABS housing with a flat acrylic plastic retro-reflective lens, hermetically sealed to it, capable of reflecting incident light from wide angles. The delineator shall be mounted to the top or side of the barrier with a butyl pad, epoxy or solvent cement.

- (1) PHYSICAL REQUIREMENTS.** The delineator shall be white and the reflective surface shall be either crystal or yellow. The housing dimensions shall be approximately 3 inches high, 5-1/4 inches wide and 2-1/2 inches deep. The projected reflecting surface area shall be approximately 9.5 square inches. The body surface shall be smooth, except for identification, to facilitate self cleaning.

The material for the housing shall be acrylonitrile butadiene styrene (ABS). The material used for the reflective area shall be methyl methacrylate plastic and must conform to FS LP-380C, Type 1, Class C.

After exposure for one hour to an ambient temperature of 125°F (52° C) maximum the assembly shall meet all optical and physical requirements.

**(2) OPTICAL REQUIREMENTS.**

**(a) Definitions.**

**Horizontal Entrance Angle** - The angle in the horizontal plane between the mounting plane (concrete barrier) and the incident light. The horizontal entrance angle shall be considered as plus in the direction from the mounting plane toward the normal to the reflector face. Only plus angles shall be measured.

**Observation angle** - The angle formed between the line from the light source to the reflector and the line from the reflector to the observer's eye.

Specific intensity - The candlepower, in foot-candles, of the returned light at the chosen observation and entrance angles for each foot candle of illumination at the reflector face on a plane perpendicular to the incident light.

- (b) **Optical Performance.** When the delineator is oriented in the photometric device with its long axis vertical and mounted to simulate mounting on the vertical side of a concrete barrier, the specific intensity of the crystal (white) reflecting surface at 0.1 degree observation angle shall be as follows:

<b>HORIZONTAL ENTRANCE ANGLE</b>	<b>SPECIFIC INTENSITY</b>
+ 0 degrees	140
+ 20 degrees	55

For yellow delineators, the specific intensity shall be 60 per cent of the value for white.

- (c) **Optical Testing Procedure.** The delineators to be tested shall be located with the center of the reflective area at a distance of 100 feet from a uniformly bright light source having an effective diameter of 2 inches. The photocell shall have an aperture of 0.5 inch diameter, and shall be shielded to eliminate stray light. The distance from the center of the light source to the center of the photocell aperture shall be 2.09 inches. If a test distance of other than 100 feet is used, the source and receiver dimensions along with the distance between source and receiver shall be modified in the same proportion as the test distance. In no case shall the test distance be less than 10 feet.

Determination of acceptability shall be based on MIL- STD-105D using an AQL of 2.5.

- (d) **Delineator.** Barrier delineators such as Model H962 manufactured by the Signal Products Division, Amerace Corporation 7542 No. Natchez Street, Niles, Illinois 60548; Models JD-1 or JD-2 as manufactured by Astro Optics Corporation, 924 Morse Street, Schaumburg, Illinois 60192; or approved equivalent are acceptable.

- (C) **GUARDRAIL DELINEATORS.** The guardrail delineator shall consist of an ABS housing with a flat acrylic plastic retro-reflective lens, hermetically sealed to it, capable of reflecting incident light from very wide angles. The housing shall be attached to the guardrail with butyl pads, epoxy or solvent cement.

- (1) **PHYSICAL REQUIREMENTS.** The delineator shall be white and the reflective surface shall be either crystal or yellow. The housing shall be approximately 5-5/16 inches high, 2-3/8 inches wide and 15/16 inches deep. The projected reflecting surface shall be a minimum of approximately 6-1/2 square inches.

The 1/2 inch x 3-1/2 inch wing of the device will emit a signal from -5 degrees to +70 degrees. The wide angle reflector performance shall be retained in all conditions, rain, fog, or snow.

The material for the housing shall be acrylonitrile butadiene styrene (ABS). The material used for the reflective area shall be methyl methacrylate plastic and conform to FS-LP-380C, Type 1, Class C.

**(2) OPTICAL REQUIREMENTS.**

**(a) Definitions.**

Horizontal Entrance Angle - The angle in the horizontal plane between the mounting plane (guardrail) and the incident light. The horizontal entrance angle shall be considered as plus in the direction from the mounting plane toward the normal to the reflector face.

Observation angle - The angle formed between the line from the light source to the reflector and the line from the reflector to the observer's eye.

Specific Intensity - The candlepower, in foot-candles, of the returned light at the chosen observation and entrance angles for each foot candle of illumination at the reflector face on a plane perpendicular to the incident light.

**(b) Optical Performance.** When the delineator is oriented in the photometric device with its long axis vertical and mounted to simulate mounting within a guardrail, the specific intensity of the crystal (white) reflecting surface at 0.1 degree observation angle shall be as follows:

<b>HORIZONTAL ENTRANCE ANGLE (degrees)</b>	<b>SPECIFIC INTENSITY</b>
-5 (OR)	10
0 (HV)	20
+5 (RS)	20
+10 (RS)	20
+20 (RS)	20
+45 (RS)	25
+50 (RS)	25
+70 (RS)	10

Note: OR - Off Roadway Side

RS - Roadway Side

HV - Horizontal, Vertical axis of reflector

For yellow delineators, the specific intensity shall be 60 per cent of the value for crystal (white).

**(c) Optical Testing Procedure.** The delineators to be tested shall be located with the center of the reflective area at a distance of 100 feet from a uniformly bright light source having an effective diameter of 2 inches. The photocell shall have an aperture of 0.5 inch diameter, and shall be shielded to eliminate stray

light. The distance from the center of the light source to the center of the photocell aperture shall be 2.09 inches. If a test distance of other than 100 feet is used, the source and receiver dimensions along with the distance between source and receiver shall be modified in the same proportion as the test distance. In no case shall the test distance be less than 10 feet.

Determination of acceptability shall be based on MIL- STD-105D using an AQL of 2.5.

- (d) **Delineator.** Guardrail delineators such as Model #962 manufactured by the Signal Products Division, Amerace Corporation 7542 North Natchez Street, Niles, Illinois 60548; Model GR-1 as manufactured by Astro Optics Corporation, 924 Morse Street, Schaumburg, Illinois 60193; or approved equivalent are acceptable.

#### 822.14 IMPERVIOUS SUBGRADE MATERIAL

Polyethylene sheeting used as an impervious sub-grade material shall conform to the requirements of AASHTO M 171 except the color shall not be restricted and the moisture retention and apparent daylight reflectivity requirements will not apply. The average thickness of the sheeting shall not be less than one mil (0.001 inch).

#### 822.15 FORMULATED LATEX MODIFIER

Latex shall be a non-toxic, film forming, polymeric emulsion to which all stabilizers have been added at the point of manufacture and shall be homogeneous, uniform in composition, and free from chlorides. The latex modifier shall conform to the following requirements:

<b>PROPERTY</b>	<b>VALUE</b>
Butadiene Content	30-40%
Solids	46-53%
Weight	8.40-8.47 lb/gal
pH	9.0-12.0
Coagulum	Max. 0.10%
Surface Tension	Max. 50 dynes/cm
Mean Particle Size, polymer A	1400-2500
Freeze-Thaw stability	Max. 0.10%
Color	White
Shelf Life	Min. 2 years

Each shipment of latex modifier shall be accompanied by a report of tests performed in accordance with the Certification Program contained in Section VII of Report No. FHWA-RD-78-35. The report shall include date of manufacture, batch or lot number(s), quantity represented, manufacturer's name, place of manufacture, and the date on which the one-year certification period will expire. Values for viscosity and density spectrographs of the solid portion and volatile portion shall be provided in the report.

**822.16 PIPE JOINTING COMPOUND**

(A) **PHYSICAL PROPERTIES.** Pipe jointing compound shall have a bituminous base and shall adhere firmly to the glazed surface of pipes. It shall melt freely at 250°F. When set hard it shall be sufficiently elastic to permit a slight movement of the pipe without injury to the joints or breaking of the adhesion of the compound to the pipes.

(B) **CHEMICAL PROPERTIES.**

	<b>Minimum</b>	<b>Maximum</b>
Specific gravity at 77oF	1.00	1.50
Bitumen soluble in CS <sub>2</sub> percent	50	-----
Loss in weight, 5 hrs., 50 gm at 400°F	-----	1.00
Melting point (Ring and Ball), °F	200	-----

The compound must withstand five (5) days immersion in five (5) percent solution of KOH and five (5) days immersion in one (1) percent solution of HCl.

## 823 ROADSIDE IMPROVEMENTS

### 823.01 TOPSOIL

- (A) Topsoil shall be natural, surface soil, in a friable condition and shall contain not less than 3% subsoil. The topsoil shall be free of hardpan material, stones and clods larger than ½ inch in diameter, sticks, tree or shrub roots, debris, toxic substances (i.e., residual pesticides) and other material detrimental to plant growth. The area to be planted and the topsoil shall be free of plant, plant seed, or plant parts of undesirable plants such as, but not limited to, bermuda grass, nut sedge, mugwort, Johnson grass, quack grass, Canada thistle or noxious weeds as set forth in the Federal Seed Act.
- (B) The Contractor shall notify the Chief Engineer of the location of all sources of the topsoil and shall furnish the Chief Engineer a certified report from the agricultural experiment station or approved agricultural laboratory of an analysis performed not more than 60 calendar days prior to the date of submission. The topsoil shall be certified to meet the following requirements:
  1. Soil shall be a natural, original surface soil of a sandy loam texture with a mechanical analysis of 60-65% sand, 15-25% silt and 10-15% clay.
  2. Soil shall be at least 2%, but not more than 5%, organic matter.
  3. Soil pH shall be from 5.5 to 6.6 inclusive unless otherwise specified.
  4. Soil salinity, measured by electrical conductivity, shall not exceed 500 parts per million (ppm) as determined by "Method of Soil Analysis" Part 2, published by the American Society of Agronomy, 1965.
- (C) The soil nutrient level shall be greater than 100 lbs/acre of magnesium, 150 lbs/acre of phosphorus and 120 lbs/acre of potassium. Limestone as per 823.02(F) may be used to adjust an acidic condition and shall be thoroughly mixed by volume. No more than 5 pounds of limestone per cubic yard of topsoil may be used for this purpose.
- (D) Topsoil that has been synthesized by blending materials that do not individually meet the requirements of this specification will not be accepted even though the resulting blend meets the organic matter, mechanical analysis, pH and soluble salts requirements.
- (E) The Chief Engineer reserves the right to inspect and sample all topsoil at the source and/or at the time of delivery, at no additional cost to the Contractor.
- (F) Topsoil must not be delivered or handled in a frozen or muddy condition.
- (G) All topsoil must be approved by the Chief Engineer before delivery to the job site. Material not meeting requirements of this specification may be rejected on or after delivery.

### 823.02 FERTILIZERS

- (A) **FERTILIZER FOR SEEDING.** Fertilizer shall be a standard commercial grade as per standards of the Association of Official Analytical Chemists and shall contain the equivalent of 10 percent nitrogen, 6 percent phosphoric acid, and 4 percent potash by

weight, and shall be applied to all seeding and sodding areas at the rate of 1,000 lbs. per acre.

Fertilizer shall be furnished in new, clean, sealed, and properly labeled bags.

- (B) **FERTILIZER FOR HYDROSEEDING (Crownvetch).** Standard quality commercial 0-20-20 farm grade fertilizer shall be applied at the rate of 500 pounds per acre (12 pounds per 1,000 square feet) combined with Ureaform (38-0-0) or Blue Chip Nitroform, Kapco-38, or equivalent, applied at the rate of 400 pounds per acre (9 pounds per 1,000 square feet). Ureaform 38-0-0 shall meet the following additional requirements:

Total nitrogen (TN)	38.0 percent minimum
Water-insoluble Nitrogen	27.0 percent minimum
Activity Index (AI)	40.0 percent minimum
Urea Nitrogen	3.5 percent maximum

- (C) **STABLE MANURE USED FOR PLANTING.** Manure shall be well rotted, unleached horse and/or cow manure, free from shavings, sawdust, or refuse, and shall not contain material harmful to plant growth. It shall be not less than 6 months old nor more than 2 years old.
- (D) **UREAFORM FERTILIZER FOR PLANTING.** Ureaform fertilizer shall be granular or pelletized with a 38-0-0 analysis.
- (E) **MICROPORE FERTILIZER RELEASE PACKETS.** Micropore fertilizer release packets shall be used during the planting in accordance with packet manufacturer’s instructions, or as specified. Each packet shall be sealed in a polyethylene laminated envelope and shall contain a minimum soluble fertilized analysis of 16% nitrogen, 8% phosphorus and 16% potash. Packets shall be 4 ounces, 8 year release packages as approved by the Chief Engineer.
- (F) **LIME.** Lime, if necessary to adjust soil pH for grass renovation, shall consist of an agricultural calcic or dolomitic ground limestone containing at least 85 percent of total calcium and magnesium carbonates. Limestone shall be per standards of the Association of Official Agricultural Chemists.

Lime shall meet the following grading analysis:

SIEVE SIZE PASSING BY WEIGHT	MINIMUM PERCENT
No. 100	40
No. 8	95

Lime shall be applied to all grass areas at the rate of 3,000 lbs. to the acre. It shall be evenly spread and well incorporated into the soil.

**823.03 SEED**

- (A) **SEED FOR GRASS.** Seed mixes and seed shall meet the requirements listed in Table 823.03. The germination portion of Crown vetch seed shall consist of 35 percent normal sprouts and 35 percent hard seed.

Seed sown from March 1 to April 30 and from August 15 to October 31 shall be Seed Mix No. 1, Seed Mix No. 2, or Seed Mix No. 3, as specified in the Special Provisions. If not specified or directed in writing, Seed Mix No. 1 shall be used.

Seeding with the above mixes at other than the indicated dates may be allowed upon written approval.

Seed Mixes No. 1 and No. 2 shall be sown at the rate of 100 pounds per acre or 2-1/2 pounds per 1,000 square feet.

Seed sown from May 1 to July 31 shall be Korean Lespedeza (*Lespedeza stipulaces*). This seed shall be sown at the rate of 40 pounds per acre.

Korean Lespedeza (*Lespedeza stipulaces*) may be sown from February 15 through March 31. This seed shall be sown at a rate of 30 pounds per acre or 1 pound per 1,000 square feet. Apply 200 pounds of 10-10-10 fertilizer per acre and apply lime if pH is less than 5.5.

- (B) **CROWN VETCH SEED FOR HYDROSEEDING.** Seed Mix No. 3 shall be used. Crown vetch seed, sown at the rate of 20 pounds per acre, shall be 95 percent pure with 70 percent germination of which a minimum of 35 percent shall be normal sprouts and the remaining hard seed. The total mixture, including the companion nurse grass seed, shall be sown at the rate of 80 pounds per acre or 1-3/4 pounds per 1,000 square feet.

All seed shall be from the last available crop. No seed shall be accepted with a date of test of more than 9 months prior to date of sowing. All seed shall be labeled, tagged, or marked in accordance with the best practice and according to law.

**TABLE 823.03 SEED MIXTURES**

	<b>Purity (percent)</b>	<b>Germination (percent)</b>	<b>Maximum Weed Seed (percent)</b>
SEED MIX NO. 1 75% Kentucky Blue Grass (Poa pratensis)	85	75	0.75
20% Red Fescue (Festuca rubra)	95	80	0.50
(Illahee Strain)	92	90	1.00
5% Red Top (Agrostia alba)			
SEED MIX NO. 2 70% Kentucky 31 Fescue (Festuca elatior)	98	90	0.50
30% Red Fescue (Festuca rubra)	95	80	0.50
(Illahee Strain)			
SEED MIX NO. 3 35% Perennial Rye Grass (Lolium perenne)			
35% Kentucky 31 Fescue (Festuca elatior)	98	90	0.50
arundinaceae)	98	90	0.50
30% Crownvetch (Coronilla varia Var. Penngift)	95	70	
OTHER SEEDS Korean Lespedeza (Lespedeza stipulaces)	98	70	0.75

**823.04 MULCH**

(A) **MULCH FOR SEEDING.** Material used for mulching in seeding areas shall be wheat or oat straw, rye or other approved hay or stems resulting from harvesting seed or approved herbaceous mowings. All mulch material shall be reasonably free from weed seed, mold, and foreign matter and shall not contain sticks larger than 1/4-inch in diameter.

Straw mulch shall be in an air-dry condition and suitable for placing with mulch blower equipment.

- (B) Hydromulch shall be wood cellulose fiber mulch. Degradable green dye wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydromulching.
- (C) **MULCH FOR PLANTING.** Mulch shall be medium grade and free from matter injurious to plant growth and shall be one of the following:
- (1) Tanbark
  - (2) Hardwood
  - (3) Root bark

### 823.05 SOD

Sod for residential areas shall be well rooted Kentucky Blue Grass (*Poa pratensis*) containing a growth of not more than 30 percent of other grasses and clovers and free from noxious weeds, Bermuda grass, wild mustard, and crabgrass. Soil adhering to roots shall be not less than 1 inch thick and as uniform as practicable.

Sod for non-residential roadside areas shall be a certified grass mixture of 90 percent Tall Fescue and 10 percent Kentucky Blue Grass, or a percentage acceptable to the Chief Engineer. Improved varieties of Tall Fescue such as Finelawn, Bonanza, Mustang or Crossfire are acceptable. Sod shall be free from noxious weeds such as Bermuda grass, wild mustard and crabgrass.

Sod shall be well rooted and field grown for a minimum of 12 months. Sod shall be placed within 48 hours of being cut and rolled. It shall be cut into strips not less than 14 inches nor more than 20 inches in width. Sod shall be machine cut to a uniform thickness of  $\frac{3}{4}$  inch,  $\pm 1/4$  inch, at the time of cutting. Thickness shall exclude top growth and thatch. Sod shall be relatively free of thatch ( $3/8$  inch or less) at time of cutting.

### 823.06 PEAT

- (A) **PEAT MOSS FOR PLANTS AND PLANTING.** Peat moss shall be granulated sphagnum peat moss nearly free from woody substances, consisting of at least 75 per cent of partially decomposed stems and leaves of sphagnum and essentially brown in color. Texture may vary from porous-fibrous to spongy-fibrous and shall be free from sticks, stones and mineral matter. Peat moss shall be in an air-dry condition, shall have a pH of 3.5 to 5.5, and shall otherwise be per federal regulation. Peat moss shall be moistened prior to and at time of use.
- (B) **PEAT HUMUS FOR PLANTS AND PLANTING.** Peat humus shall be a natural peat or peat humus from fresh water saturated areas, consisting of sedge, sphagnum, or reed peat deposits in which the organic matter consists of incompletely decomposed residues containing a minimum of 70% organic material by weight. Humus shall be free from sticks, stones, roots, and other objectionable materials. Samples taken at the source of supply shall show the following analysis:

pH range	4.0 to 7.5
Water absorption ability	200 percent by weight min. on oven-dry basis

Organic content: 60 percent min. when dried at 105° C

### 823.07 PLANT MATERIALS

- (A) **QUALITY.** All plants, unless otherwise specifically permitted, shall conform to the standards of the current edition of “American Standard for Nursery Stock” as approved by American Standards Institute, Inc.

All plant grades shall be those established in the current edition of American Standards for Nursery Stock manual. Only one size per grade will be listed rather than a size range. The one size shall mean the minimum size for that grade and shall include plants from that size up to but not including the next larger grade size.

- (B) **PLANTS.** Plants shall be defined as tress, shrubs, vines and plants of all descriptions. Unless otherwise specified, all plants shall be nursery grown stock that has been transplanted or root trimmed two or more times, according to the kind and size of plants. Furnished plant material shall be certified by State or Federal Department of Agriculture to be free from disease or infestation.

All plant materials shall have normal, well developed branches and a vigorous root system. The branch system shall have normal development and be free from disfiguring knots, sun-scald, injuries, abrasions of the bark, dead or dry wood, broken terminal growth, insect eggs and infestations, or other objectionable disfigurements. The plants shall be healthy and free from physical defects, plant diseases, and insect pests. Plant materials grown in fields or blocks that show evidence of containing any parts of Johnsongrass or Canada Thistle will be rejected.

- (C) **PLANT NAMES.** All scientific and common plant names shall per “Standardized Plant Names” as adopted by the American Joint Committee on Horticultural Nomenclature. All plants shall be true to name and legibly tagged with the names and sizes of material.

- (D) **GRADING STANDARDS.** Grading of plants, including Balled and Burlapped Specifications, Bare Root Specifications, Nursery, Collected, Container Grown and Seedling Stock shall be as per American Standard for Nursery Stock, as approved by the American Association of Nurserymen, Inc., latest edition (ANSI Z60.1).

- (E) **PLANT DIGGING AND HANDLING.** All plants shall be dug in conformance with the digging specifications in the current edition of American Standard for Nursery Stock, unless otherwise specified.

All bare root deciduous plants shall be shipped in a dormant condition. Roots shall be adequately protected and kept moist.

- (F) **PLANT SUBSTITUTION.** No substitutions shall be made without prior permission of the Chief Engineer.

In cases where plant materials are not available at the time of planting, the Contractor shall submit written evidence that the plants are unavailable. The Chief Engineer may determine a suitable substitution.

**823.08 PLANTING MATERIALS**

- (A) **PEAT MOSS** shall meet the requirements of 823.06(A).
- (B) **PEAT HUMUS** shall meet the requirements of 823.06 (B).
- (C) **STABLE MANURE** shall meet the requirements of 823.02 (C ).
- (D) **STAKES.** Stakes used to support trees shall be rough sawn, straight grain hardwood reasonably free from knots, bark, wane, warp and splits, as determined by the Chief Engineer. Stakes shall be full cut 2x2 inch thickness. The stake lengths shall be as indicated in the contract documents.
- (E) **GUYING & STAKING WIRE.** Wire shall be new, soft annealed galvanized steel wire, free from bends and kinks. No. 10 wire shall be used in guying and No. 12 wire shall be used in staking. Turnbuckles used in guying shall be galvanized steel or zinc coated, as per 811.07.
- (F) **HOSE.** Hose used with wire for guying and staking shall be 5/8 inch I.D. new garden or steam hose.
- (G) **ANTIDESICCANT.** Antidesiccant, for retarding excessive loss of plant moisture and inhibiting wilt, shall be an approved emulsion that will provide a film over plant surfaces permeable enough to permit transpiration. Antidesiccant shall be used only after approval by the Chief Engineer.
- (H) **HERBICIDES.** Herbicide shall be an EPA-approved chemical to control and prevent re-growth of undesirable vegetation. The herbicide will be subject to approval by the Chief Engineer.

## 824 SIGNING MATERIALS

### 824.01 SIGN POSTS

- (A) **WOOD GROUND MOUNT SIGN POSTS.** See 822.12(C).
- (B) **STEEL POSTS.** See 824.03.

### 824.02 REFLECTIVE SHEETING

Reflective sheeting for sign panel faces shall meet the requirements of AASHTO M 268 (D4956-01a) for Type III, Type VI and/or Type IX as required by the contract documents. The Backing for the reflective sheeting shall meet the requirements of AASHTO M 268 (D4956-01a) for Class 1, 2 and 5. The colors of the reflective sheeting shall conform to the standard traffic colors per the Manual of Uniform Traffic Control Devices current edition.

- (A) Type III Retro-reflectivity requirements shall conform to AASTO M268 and the following.

<b>MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE III SHEETING</b>								
<b>Minimum Coefficient of Retroreflection (RA) cd/(lx · m<sup>2</sup>)</b>								
Observation Angle°	Entrance Angle°	White	Yellow	Red	Orange	Green	Blue	Brown
0.2	+50	75	40	8.4	25	10.3	2.9	1.6
0.5	+50	35	20	6.8	10	6.4	2	1.1

- (B) Type VI Retro-reflectivity requirements shall conform to AASTO M268 as specified.
- (C) Type IX Retro-reflectivity requirements shall conform to AASTO M268 and the following.

<b>MINIMUM REFLECTIVE INTENSITY VALUES FOR</b>										
<b>HIGH PERFORMANCE WIDTH ANGLE PRISMATIC LENS SHEETING</b>										
<b>Minimum Coefficient of Retro-reflection· (RA) cd/(lx · m<sup>2</sup>)</b>										
Observation Angle°	Entrance Angle°	White	Yellow	Red	Orange	Green	Blue	Fluorescent Yellow	Fluorescent Green	Fluorescent Orange
0.2	-4	380*	300	98	145*	45	22	240	325	140
0.2	+30	225	180	65	82*	28	14	150	200	90
0.5	-4	275	220	70	90*	32	17	165	235	105
0.5	+30	135*	100*	32	50*	16	8	75	105	50
1.0	-4	80*	60*	20	30*	9	4.5	45	65	30
1.0	+30	45*	35*	11	11*	6	3	24	35	15

\*AASHTO M268 - Table 3

- (D) Temporary Roll Up Warning Signs shall conform to AASTO M 268 Type VI.
- (E) Black Sheeting shall be nonreflective.

#### **824.03 STEEL SIGN STRUCTURES**

The following material requirements apply: Steel Pipe - ASTM A 53, Type F; galvanized per ASTM A 386, Class B-1 plus ASTM A 384 and A 385; with 25,000 psi minimum yield stress; used for diagonals and verticals 4-1/2 inches O.D. and under.

ASTM A 53, Types E and S, Grade B galvanized per ASTM A 386, Class B-1 plus ASTM A 384 and A 385; with 35,000 psi minimum yield stress; used for truss chords, columns, and ground mount sign posts 4-1/2 inches O.D. and over.

Equivalent galvanized tapered tube sections may be used in place of above requirements provided there are no alterations to other sign structure detail.

Steel Plates & Shapes - AASHTO M 183 and galvanized per AASHTO M 111.

Steel Castings - AASHTO M 103, Grade 65-35 and galvanized per AASHTO M 111.

Catwalk Gratings - Borden Type B-7, Blaw-Knox Type 8N21, Irving Type A-A; or approved equal.

Pipe Connections and Couplings - Victaulic Turnpike type or approved equal and galvanized per ASTM A 153.

Post Caps - Cast post caps shall be black iron per ASTM A 48 or carbon steel per ASTM A 27 and galvanized per ASTM A 153.

Turned and U Bolts and Nuts per ASTM A 307 and galvanized per ASTM A 153.

Anchor Bolts and Nuts and Washers - Carbon steel high strength bolts per AASHTO M 164, or Alloy Steel high strength bolts per ASTM A 490, and galvanized per ASTM A 153.

#### **824.04 GUIDE SIGN PANELS, TRAFFIC SIGN PANELS, HAZARD DELINEATORS, DEMOUNTABLE CHARACTERS AND DELINEATORS**

Sheets and Plates for sign panels shall be 6061-T6 aluminum alloy meeting requirements of ASTM B 209. Alloy GS 11A, Condition T6.

Angles, Zees, and Lock Tabs for sign panel framing shall be extruded shapes of 6061-T6 aluminum alloy meeting requirements of ASTM B 221, Alloy GS11A, Condition T6.

Support Angles shall be AASHTO M 183 steel galvanized to requirements of AASHTO M 111.

Panel hardware, unless otherwise specified on the plans or herein, shall be stainless steel meeting requirements of ASTM A 276, Series 300 or clear anodized 2024-T4 aluminum alloy rod meeting requirements of ASTM B 211, Alloy CG42A. Reflective Sheeting shall meet requirements of 824.02.

Insulation shall be laminated insulating sheets meeting the requirements of Military Specification MIL-P-15035, Type FBM, FEG, FBE, or insulation sleeves meeting

requirements of Military Specification MIL-P79B, Type FBM, FEG, or FBE. Samples of 9 insulating materials shall be submitted to the Chief Engineer for approval prior to use.

Demountable Characters and Borders shall consist of embossed aluminum frames which are covered with reflective sheeting. As required, reflector buttons shall be mounted on the characters and borders.

Characters shall be fabricated from 0.04 inch sheet aluminum conforming to AASHTO M 290. All demountable letters and numerals shall be Federal Highway Administration Standard Alphabet, Modified Series E. Mounting holes shall be provided for fastening to sign panel; spacing of mounting holes shall be determined by character size and shape, but in no case shall holes be spaced more than 8 inches on center.

Reflector Buttons shall conform to AASHTO M 290 and shall be designed to be mounted on demountable characters and demountable sign borders by mechanical means that require no adhesive.

Hazard Delineator and Delineator Reflectors shall consist of minimum 3 inch diameter, amber or colorless reflector units, as specified, meeting reflector button requirements as specified above. Specific brightness per amber reflectors shall be 60 percent of values shown for colorless reflector buttons.

Each reflector shall be mounted in a 5032-H32 aluminum housing formed to enclose the circumferential edge and back of reflector. Housing shall contain a single center mounting hole into which an aluminum grommet shall be expanded to an inside diameter of 3/16 inch. Mounting hardware shall be 2024-T4 aluminum alloy of vandal resistant design.

Non-Demountable Characters shall consist of cutouts of reflective sheeting applied directly to sign background. Reflective sheeting shall meet requirements of 824.02. Non-demountable letters and numerals shall be Federal Highway Administration Standard Alphabet Series specified on the plans. Where Interstate Route Delineators are required for guide signs using non-demountable characters, the delineator shields also shall be cutouts of reflective sheeting applied directly to sign face.

Silk Screen Paste for traffic signs shall be high quality black opaque face or transparent overlay type suitable for exterior use. The dry film shall be tough, smooth, hard, and free from all defects such as sagging, checking, wrinkling, and orange peeling.

Black silk screen paste shall be opaque, and formulated so that paste will not dry in the screen in less than 2 hours. It shall flow out and level uniformly over the screened area without running, sagging, or streaking.

Silk screen paste for transparent overlay shall be of such formulation that it can be applied by silk screen process to reflective sheeting so as to produce a true color, both under direct and reflected light. Paste ingredients shall be compatible with reflective sheeting surface so proper adhesion will result with no deterioration to the reflective sheeting. Green, red, and blue transparent overlay silk screen paste shall be approved and shall match the color standards of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD).

## 825 TRAFFIC SIGNAL MATERIAL

### 825.01 GENERAL

Light emitting diode (led) traffic signal modules, Light emitting diode (led) pedestrian signal modules, Conventional polycarbonate vehicle signal head, Conventional polycarbonate pedestrian signal head, mast arm mount signal bracket, Light emitting diode (led) countdown pedestrian signal modules, controller cabinets Model 200 switch packs, traffic signal cables, and other miscellaneous traffic signal material shall meet the requirements of this section and as shown in the contract documents.

### 825.02 LIGHT EMITTING DIODE (LED) TRAFFIC SIGNAL MODULES

The acceptable design and operating requirements for 12 inch (300 mm) Light Emitting Diode (LED) vehicle signal modules are listed in this section. The specific items covered under this specification include the red ball, the yellow ball, the green ball, the red arrow, the yellow arrow, and the green arrow.

#### (A) DESCRIPTION.

- (1) This specification covers “red ball”, “yellow ball”, “green ball”, “red arrow”, “yellow arrow” and “green arrow” LED modules to be used in place of the incandescent lamp, reflector, socket, gasket and lens assembly of the vehicle signal sections. Each LED module shall consist of an assembly that utilizes LEDs as the light source in lieu of an incandescent lamp for use in vehicle signal sections.
- (2) All vehicle signal LED modules shall be Chief Engineered to fit into all ITE compliant conventional vehicle signal housings. They shall fit in the conventional polycarbonate vehicle signal head housing, as used in the District of Columbia, and as described in detail in an accompanying technical specification.
- (3) The LEDs utilized in the modules shall be AllnGap technology for red and yellow indications or InGaN for green indications. The LED’s shall be the ultrabright type rated for 100,000 hours of continuous operation from -40° C to +74° C.
- (4) Each LED module shall be rated for a minimum useful life of 48 months. All LED modules shall meet all parameters of this specification during this period.
- (5) Each individual LED module shall be wired such that a catastrophic loss or the failure of one LED will result in the loss of not more than 5% of the signal module light output.
- (6) Each “red ball” and “green ball” module shall be in full compliance of all provisions of the July, 1998 Institute of Transportation Engineers Interim LED Purchase Specification, Vehicle Traffic Control Signal Heads, Part 2.

#### (B) ELECTRICAL REQUIREMENTS

##### (1) Power Consumption

The maximum power consumption requirements measured in watts for each module are as follows:

<b>MODULE</b>	<b>25°C</b>	<b>74°C</b>
Red Ball	11.0W	17.0W
Yellow Ball	22.0W	25.0W
<b>MODULE</b>	<b>25°C</b>	<b>74°C</b>
Green Ball	15.0W	15.0W
Red Arrow	9.0W	12.0W
Yellow Arrow	10.0W	12.0W
Green Arrow	11.0W	11.0W

All LED Modules except the yellow ball shall be U.S. EPA Energy Star compliant at 25°C. Power consumption of these LED Modules shall not exceed that maximum allowed by the EPA.

**(2) Operating Voltage**

Each module shall operate from a 60HZ±3HZ AC line over a voltage ranging from 95 volts to 135 volts. Fluctuations of line voltage shall have no visible effect upon the luminous intensity of the indications. The operating voltage of the modules shall be 120 Volts AC. All operating parameters shall be measured at this voltage. LED circuitry shall prevent perceptible flicker to the unaided eye over the 95 to 135 voltage range.

- (3)** The LED module shall have a power factor of 0.90 or greater at a nominal rated voltage at 25°C after 60 minutes of operation.
- (4)** Total harmonic distortion (current and voltage) induced into an AC power line by an LED signal shall not exceed 20 percent at the rated voltage at 25° C.
- (5)** The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients as stated in Section 2.1.6 of the NEMA Standard TS-2 dated 1992.
- (6)** Each LED module and associated on-board circuitry shall be in compliance with Federal Communications Commission (FCC) noise regulations and must meet FCC Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
- (7)** All wiring and terminal blocks must meet the requirements of Section 13.02 of the ITE Publication: Equipment and Material Standards, Chapter 2, Vehicle Traffic Control Signal Heads.
- (8)** Each LED module shall be operationally compatible with controller assemblies and peripheral equipment including sold state load switches; flashers, and conflict monitors currently used in the District of Columbia. Current controller specifications are available for review at the specific request of the contractor or vendor.

When a current of 20 mA AC or less is applied to the unit, the voltage read across the two leads shall be 15 VAC or less.

- (9) Each LED module shall feature control circuitry to prevent current flow through the LED module in the off state to avoid any false indication as may be perceived by the human eye during the daylight and evening hours.
- (10) Two secured, color coded, 600 V, 16 AWG minimum jacketed wires conforming to the National Electrical Code, rated for service at + 105° C, are to be provided for electrical connections for each LED signal module. Section 5.5 of these specifications includes more detail relevant to these conductors.
- (11) Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of 2 amps shall be provided to minimize the effect and repair cost of an extreme over-voltage situation of other failure mode.

**(C) ENVIRONMENTAL REQUIREMENTS**

- (1) Each LED module shall be rated for use in operating temperatures in the range of -40° C (-40° F) to +74° (+165° F). Each LED module shall meet all specifications throughout this temperature range.
- (2) Each LED module shall be protected against dust and moisture intrusion in conformance with NEMA Moisture Resistant Standard 250-1991 for Type 4 enclosures to protect all internal components.

**(D) COMPONENTS**

- (1) Each LED module shall be a single, self-contained sealed unit, not requiring on-site assembly for installation into an existing traffic signal housing.
- (2) The power supply for the LED module shall be integral to the unit.
- (3) The circuit board and the power supply shall be contained inside the module.
- (4) Each LED module shall incorporate a printed circuit board containing all required LED's and circuit components. The LED's shall be mounted and soldered to the printed circuit board.
- (5) Each LED module shall feature two 39 inch long 20 AWG wire leads with strain relief and spade terminals for connection to the terminal block of the signal head. One of the conductors shall contain white insulation to signify neutral. The color of the other conductor shall be different and shall be used to differentiate between the red ball, yellow ball, green ball, red arrow, yellow arrow and green arrow LED module. Conductor colors shall be unique and different for those used for pedestrian signal indications also.
- (6) Each LED module shall feature a rigid housing for protection in shipping, handling, and installation, and a one-piece neoprene gasket. Screw-in type products are expressly prohibited for LED modules.
- (7) The assembly and manufacturing process for the LED signal assembly shall be designed to ensure that all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.
- (8) Each LED module shall be watertight when properly installed in a traffic signal housing. Each LED module shall utilize the same mounting hardware used to secure

the incandescent lens and gasket assembly, and shall only require a screwdriver or a standard installation tool to complete the mounting.

- (9) Each LED module shall weigh less than 5 pounds.
- (10) Each LED module shall be designed to be installed in the doorframe of a standard traffic signal housing. Each LED module shall be capable of being sealed in the doorframe with a one piece EPDM (ethylene, propylene rubber) gasket.
- (11) Each LED module shall be weatherproof after installation and connection.

#### **(E) MATERIALS**

- (1) Materials used for the lens and signal module shall conform to the appropriate ASTM specifications for the materials.
- (2) Enclosures containing either the power supply or electronic components of the signal module shall be made of UL94VO flame retardant materials. The module lens does not need to conform with this requirement.
- (3) The lens of the LED module shall be integral to the unit, shall be convex with a smooth outer surface and shall be made ultraviolet stabilized plastic material.
- (4) Each LED module lens shall be capable of withstanding ultraviolet (direct sunlight) exposure for a minimum period of 5 years without exhibiting evidence of deterioration.
- (5) A surface coating or chemical surface treatment shall be applied to each outer polymetric lens to provide front surface abrasion resistance.
- (6) Each LED module shall incorporate an inner Frensel lens sealed to the lamp housing to collimate the light emitted by the LED engine. The outer lens shall focus the collimated light to meet ITE intensity and distribution standards.
- (7) Each LED module shall almost perfectly approximate to the motorist the appearance of a 12 inch standard incandescent signal. The surface of the LED module shall appear to the motorist to be nearly totally uniform in illumination, and have a wide viewing angle making it suitable for installation on wide boulevards.
- (8) The external lens surface for all LED modules shall be smooth with no raised surfaces so as to minimize the collection of dirt, debris, and other particulate contaminants, which may impact luminous intensity, and to facilitate periodic cleaning. External lens facets are prohibited.
- (9) The lens for the red ball and the red arrow shall be tinted red or may use transparent film materials with similar characteristics to enhance on/off contrasts.
- (10) The lens for the yellow ball and the yellow arrow shall be tinted yellow or may use transparent film materials with similar characteristics to enhance on/off contrasts.
- (11) The lens for the green ball and the green arrow shall be clear. No tinting or transparent film materials shall be used.
- (12) The use of tinting or other materials to enhance on/off contrasts shall not affect chromaticity and shall be uniform across the face of the lens.

**(F) MODULE IDENTIFICATION**

- (1) Each LED Module shall have the manufacturers name, trademark, model number, serial number, date of manufacture (month and year) and lot number as identification permanently marked on the back of the module. This identification is required, and is in addition to any other identification that may be required in contract special provisions by the District of Columbia.
- (2) Rated voltage and rated power in Watts and Volt-Amperes shall also be permanently marked on the back of each LED module.
- (3) Each LED module shall have prominent and permanent markings for correct indexing and orientation within a signal head housing. The markings shall consist of an up arrow, or the word "UP" or "TOP" to ensure that the LED module is inserted into the signal head housing with the correct orientation.
- (4) As detailed in section 5.5 of this specification, conductors connecting the LED module to the signal head housing terminal block shall be color coded to differentiate between the red ball, red arrow, yellow ball, yellow arrow, green ball, and green arrow LED module.
- (5) Each LED module shall have a symbol of the type of module (circular ball or arrow) in the color of the module. The symbol shall be one inch in diameter, and the color shall be written in one half inch letters next to the symbol.

**(G) PHOTOMETRICS**

- (1) The minimum initial and maintained minimum intensities for red ball, yellow ball, and green ball LED modules measured in candela (cd) at 25° C shall be as follows:

Angle(v,h)	MINIMUM INITIAL INTENSITIES			MAINTAINED MINIMUM INTENSITIES		
	Red	Yellow	Green	Red	Yellow	Green
2.5,± 2.5	399	798	798	339	678	678
2.5, ± 7.5	295	589	589	251	501	501
2.5, ± 12.5	166	333	333	141	283	283
2.5, ± 17.5	90	181	181	77	154	154
7.5, ± 2.5	266	532	532	226	452	452
7.5, ± 7.5	238	475	475	202	404	404
7.5, ± 12.5	171	342	342	145	291	291
7.5, ± 17.5	105	209	209	89	178	178
7.5, ± 22.5	45	90	90	38	77	77
7.5, ± 27.5	19	38	38	16	32	32
12.5, ± 2.5	59	119	119	50	101	101
12.5, ± 7.5	57	114	114	48	97	97
12.5, ± 12.5	52	105	105	44	89	89
12.5, ± 17.5	40	81	81	34	69	69
12.5, ± 22.5	26	52	52	22	44	44

12.5, ± 27.5	19	38	38	16	32	32
17.5, ± 2.5	26	52	52	22	44	44
17.5, ± 7.5	26	52	52	22	44	44
17.5, ± 12.5	26	52	52	22	44	44
17.5, ± 17.5	26	52	52	22	44	44
17.5, ± 22.5	24	48	48	20	41	41
17.5, ± 27.5	19	38	38	16	32	32

- (1) The minimum initial and minimum maintained intensities for red arrow, yellow arrow, and green arrow LED modules measured in candelas per square meter (cd/m<sup>2</sup>) shall be as follows:

<b>MODULE</b>	<b>MINIMUM INITIAL INTENSITIES</b>	<b>MINIMUM MAINTAINED INTENSITIES</b>
Red Arrow	5,500	5,500
Yellow Arrow	11,000	11,000
Green Arrow	11,000	11,000

- (2) The red ball, red arrow, green ball, and green arrow LED module shall meet or exceed the illuminations values as shown in Section 8.1 and 8.2 throughout the useful life based upon normal use in traffic signal operations over the operating temperature.
- (3) The yellow ball and yellow arrow LED module shall meet or exceed the illumination values as shown in section 8.1 and 8.2 throughout the useful life bases upon normal use in a traffic signal operations at 25°C.
  - (a) Within 5 minutes of turn-on, the initial luminous intensity of yellow ball LED modules shall meet that of ITE compliant green ball LED modules at 25°C, 120 Volts A.C. Yellow ball LED modules shall be compliant with CALTRANS specifications. CALTRANS laboratory compliance certificates shall be furnished prior to product acceptance.
- (4) The intensity of red ball and green ball LED modules shall not vary by more than 10% over the allowable voltage range.
- (5) Red ball and green ball LED modules shall meet the July, 1998 ITE VTCSH Part II or the most current standards and measurements criteria for LED modules. Test data to verify compliance of these LED modules with this standard, including all tests listed in Section (E).4 of this standard, shall be provided from either.

Lighting Services  
7630 East Evan Road  
Scottsdale, Arizona 85260

-or-

ETL Testing Laboratories  
3933 U.S. Route 11  
Cortland, New York 13045-0950

- (a) In addition, red ball and green ball LED modules shall be compliant with Caltrans specifications. Caltrans laboratory compliance certificates shall be furnished prior to product acceptance.
- (6) Red ball, red arrow, yellow ball and yellow arrow LED modules shall utilize AllnGaP technology exclusively, either AS (Absorbing Substrate) or TS (Transparent Substrate), and shall not exhibit degradation of more than 30% of the initial light intensity following accelerated life testing (operating at 85 Degrees C and 85% humidity for 1000 hours). AlGaAs technology shall not be acceptable.
- (7) Green ball and green arrow LED modules shall utilize Indium gallium nitride (InGaN) technology. Green ball and green arrow LED modules shall not be illuminated when the applied voltage is less than or equal to 35 volts A.C. Illumination of green ball and green arrow LED modules shall be in compliance with the July, 1998 ITE VTCSH Part II when the applied voltage is between 80 and 135 Volts A.C.
- (8) The measured chromatically coordinates of the LED modules shall conform to the following chromatically requirements.
- |         |    |  |
|---------|----|--|
| RED:    | Y: | not greater than 0.308 or less than 0.998-x  |
| YELLOW: | Y: | not less than 0.411, not less than 0.995 – x, not less than 0.452                  |
| GREEN:  | Y: | not less than 0.506-0.519 x, nor less than 0.150 + 1.068x, not more than 0.730 – x |
- (10) Chromaticity requirements shall pertain to both ball and arrow LED modules.
- (11) Chromaticity requirements shall be satisfied throughout the useful life of the LED modules over the operating temperature range.
- (12) Red arrow, yellow arrow, and green arrow LED modules shall contain not less than two (2) rows of LEDs forming the shape of the arrow.
- (13) Each LED arrow module shall meet the specifications stated in Section 9.01 of the ITE Publication Equipment and Materials Standards, Chapter 2 (Vehicle traffic Control Signal Heads) for arrow indications
- (14) LEDs shall be spread and arranged evenly across the illuminated portion of the arrow area.

### 825.03 LIGHT EMITTING DIODE (LED) PEDESTRIAN SIGNAL MODULES

The acceptable design and operating requirements for 12-inch (300-mm) Light Emitting Diode

(LED) pedestrian signal modules are listed in this section. The specific items included in this specification include the “RAISED HAND” and the “WALKING PERSON” in separate modules. The “RAISED HAND” and the “WALKING PERSON” shall not be combined into a single module.

**(A) DESCRIPTION**

- (1) This specification covers LED “RAISED HAND” and the “WALKING PERSON” modules to be used in place of the incandescent lamp, reflector socket, gasket and lens assembly of the pedestrian signal section. Each LED module shall consist of an assembly that utilizes LEDs as the light source in lieu of an incandescent lamp for use in pedestrian signal sections.
- (2) Pedestrian LED modules shall be engineered to fit in all ITE compliant conventional pedestrian signal housings. They shall fit in the conventional polycarbonate pedestrian signal head housing, as used in the District of Columbia, and as described in detail in an accompanying technical specification.
- (3) Each LED Module shall utilize appropriate technology to achieve the required color and shall be the ultra bright type rated for 100,000 hours of continuous operation from -40°C to +74°C.
- (4) Each LED module shall be rated for a minimum useful life of 48 months. All modules shall meet all parameters of this specification during this period.
- (5) Each individual LED module shall be wired such that a catastrophic loss or failure of one LED will result in the loss of not more than 5 percent of the signal module light output.

**(B) ELECTRICAL REQUIREMENTS**

**(1) POWER CONSUMPTION**

- (a) The maximum power consumption requirements measured in watts for each module are as follows:

<b>MODULE</b>	<b>25°C</b>	<b>74°C</b>
“RAISED HAND”	10.0W	12.0W
“WALKING PERSON”	12.0W	15.0W

**(2) OPERATING VOLTAGE**

- (a) Each module shall operate from a 60HZ +/- 3 HZ AC line over a voltage ranging from 95 volts to 135 volts. Fluctuations of line voltage shall have no visible effect upon the luminous intensity of the indications.
- (b) The operating voltage of the modules shall be 120 Volts AC. All operating parameters shall be measured at this voltage.
- (c) LED circuitry shall prevent perceptible flicker to the unaided eye over the 95 to 135 voltage range.
- (3) The LED signal module shall have a power factor of 0.90 or greater at a nominal rated voltage at 25°C after 60 minutes of operation.
- (4) Total harmonic distortion (current and voltage) induced into an AC power line by an LED signal shall not exceed 20 percent at the rated voltage at 25°C.

- (5) The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients as stated in Section 2.1.6 of the NEMA Standard TS-2 dated 1992.
- (6) Each LED module and associated on-board circuitry shall be in compliance with Federal Communications Commission (FCC) noise regulations and must meet FCC Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
- (7) The "RAISED HAND" and the "WALKING PERSON" LED modules shall be U.S. EPA-Energy Star compliant. Power consumption of these LED modules shall not exceed the maximum allowed by the EPA.
- (8) All wiring and terminal blocks must meet the requirements of Section 13.02 of the ITE Publication Equipment And Material Standards, Chapter 2 (Vehicle Traffic Control Signal Heads).
- (9) Each LED module shall be operationally compatible with controller assemblies and peripheral equipment including solid state load switches, flashers, and conflict monitors currently used in the District of Columbia. Current controller specifications are available for review at the specific request of the contractor or vendor.
- (10) When a current of 20mA AC or less is applied to the unit, the voltage read across the two leads shall be 15 VAC or less.
- (11) Each LED module shall feature control circuitry to prevent current flow through the LED module in the off state to avoid any false indication as may be perceived by the human eye during daylight and evening hours.

**(C) ENVIRONMENTAL REQUIREMENTS**

- (1) Each LED module shall be rated for use in operating temperatures in the range of -40°C (-40°F) to +74°C (+165°F). Each LED module shall meet all specifications throughout this temperature range.
- (2) Each LED module shall be protected against dust and moisture intrusion in conformance with NEMA Moisture Resistant Standard 250-1991 for Type 4 enclosures to protect all internal components.

**(D) COMPONENTS**

- (1) Each LED Module shall be a single, self-contained device, not requiring on-site assembly for installation into an existing pedestrian signal housing.
- (2) The power supply for the LED module shall be integral to the unit.
- (3) The circuit board and the power supply shall be contained inside the module.
- (4) Each LED module shall incorporate a printed circuit board containing all required LEDs and circuit components. The LEDs shall be mounted and soldered to the printed circuit board.
- (5) Each LED module shall feature two 39-inch long 20AWG minimum wire lead with strain relief and spade terminals for connection to the terminal block of the signal heads. One of the conductors shall contain white insulation to signify neutral. The color of other conductor shall be different and shall be used to differentiate between

the “RAISED HAND” and the “WALKING PERSON” LED modules. The two conductors shall be 600 Volt, 20 AWG minimum, jacketed wires conforming to the National Electric Code, rated for service at +105°C.

- (6) Each LED module shall feature a rigid housing for protection in shipping, handling and installation and a one-piece neoprene gasket. Screw-in type products are expressly prohibited for LED modules.
- (7) The assembly and manufacturing process for the LED signal assembly shall be designed to ensure that all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.
- (8) Each LED module shall be watertight when properly installed in a pedestrian signal housing. Each LED module shall utilize the same mounting hardware used to secure the incandescent lens and gasket assembly, and shall only require a screwdriver or a standard installation tool to complete the mounting.
- (9) Each LED module shall weigh less than 5 pound

#### **(E) MATERIALS**

- (1) Materials used for the lens and signal module shall conform to the appropriate ASTM specification for the materials.
- (2) Enclosures containing either the power supply or electronic components of the signal module shall be made of UL94VO flame retardant materials. The module lens does not need to comply with this requirement.
- (3) The lens for the “RAISED HAND” LED Module and the “WALKING PERSON” LED module shall be clear with a textured surface to reduce glare.
- (4) Each LED module lens shall be UV stabilized plastic capable of withstanding ultra violet direct sunlight for a minimum period of 5 years without exhibiting evidence of deterioration.
- (5) The external lens surface shall be smooth with no raised features, so as to minimize the collection of dirt, debris, and other particulate contaminants, which may impact luminous intensity, and to facilitate periodic cleaning. External lens facets are prohibited.

#### **(F) MODULE IDENTIFICATION**

- (1) Each LED module shall have the manufacturers name, trademark, model number, serial number, date of manufacture (month and year) and lot number as identification permanently marked on the back of the module. This identification is required, and is in addition to any other identification that may be required in contract special provisions by the District of Columbia.
- (2) Rated voltage and rated power in Watts and Volt Amperes shall also be permanently marked on the back of each LED module.
- (3) Each LED module shall have prominent and permanent markings for correct indexing and orientation within a signal head housing. The markings shall consist of an up arrow, or the word “UP” or “TOP” to ensure that the LED module is inserted into the signal head housing with the correct orientation.

- (4) As detailed in Section 5.5 of this specification, conductors connecting the LED module to the signal head housing terminal block shall be color coded to differentiate between the “RAISED HAND” and the “WALKING PERSON” LED module.

### (G) PHOTOMETRICS

- (1) Each “RAISED HAND” LED module shall provide an average luminous intensity of 3,750 candela per square meter throughout the useful life and over the operating temperature range.
- (2) Each “WALKING PERSON” LED module shall provide an average luminous intensity of 5,300 candela per square meter throughout the useful life and over the operating temperature range.
- (3) The uniformity ratio of an illuminated symbol shall not exceed 4 to 1 between the highest luminance area and the lowest luminance area in the LED module.
- (4) The color output of each LED module shall conform to the requirements of Section 5.3 in the ITE Publication Equipment and Material Standards, Chapter 3, (Pedestrian Traffic Control Signal Indications).
- (a) The “RAISED HAND” within the LED module shall be Portland orange. Not greater than 0.390, not less than 0.331, nor less than 0.997 –x
- (b) The “WALKING PERSON” shall be lunar white X: not less than 0.290 nor greater than 0.330 Y: not less than 1.5x-0.175, or greater than 1.5x-0.130
- (5) Both the “RAISED HAND” and the “WALKING PERSON” LED modules shall be filled with LED’s to give the appearance that the entire image is illuminated when energized. Outlined images will not be permitted.
- (6) The height of the “RAISED HAND” and the “WALKING PERSON” images on the module shall not be less than 250 mm and the width of each image shall not be less than 165 mm.

### 825.04 LIGHT EMITTING DIODE (LED) COUNTDOWN PEDESTRIAN SIGNAL MODULES

The design and operating requirements for 12-inch (300-mm) Light Emitting Diode (LED) pedestrian signal modules intend for use where countdown displays are listed in this section. The specific items included in this specification include the 12-inch overlay lunar white walking person and Portland orange raised hand LED module and the 12-inch lunar white countdown LED module.

#### (A) DESCRIPTION

- (1) This specification covers two separate LED Modules. The first type features the Portland orange raised hand overlaid on the lunar white walking person arrayed in a module. The second type features the lunar white countdown display.
- (2) The WALKING PERSON and the RAISED HAND symbols shall conform to all applicable requirements of the Manual on Uniform Traffic Control Devices (MUTCD).

- (3) The WALKING PERSON and the RAISED HAND shall be overlaid in a special configuration which centers both within the module and provides clear and distinct illumination when either symbol is in use.
- (4) The Walking PERSON and the RAISED HAND overlaid module shall feature internal circuitry and wiring which prevent both from being illuminated at the same time.
- (5) The countdown module shall conform to the following minimum requirements:
  - (a) The countdown numbers shall feature 2 digits. Two rows of LED's shall be provided for each digit.
  - (b) Countdown logic circuitry uses A.C. power to derive timing data from the intersection traffic signal controller. The timer shall be microprocessor based
  - (c) The unit shall feature a mechanism such as a multiposition dip switch to enable the user to select specific modes for countdown functions. The unit shall be capable of displaying countdown numbers during the WALK and pedestrian clearance intervals and/or during the pedestrian clearance interval only.
  - (d) The unit shall feature a test switch which displays "8" for 2 seconds before going blank.
  - (e) The unit shall automatically adjust to the programmed intervals of the traffic signal controller. During transition between timing plans, the unit shall be dark for NO MORE than two (2) signal cycles while the unit adjusts to the new timing patterns. The WALK and DON'T WALK displays in the adjacent module shall continue to operate during this transition.
  - (f) The unit shall be capable of displaying numbers ranging from 00 to 99. Each number shall be 7 inches tall.
- (6) The WALKING PERSON, RAISED HAND and countdown displays shall be designed to be clearly visible and legible under any lighting conditions from a distance of 200 feet anywhere within a 15 degree cone centered about optical axis.
- (7) Sections 825.03 (A) (1), (2), (3), (4) and (5) apply.

**(B) ELECTRICAL REQUIREMENTS**

**(1) Power Consumption**

The maximum power consumption requirements measured in watts for each module display are as follows

MODULE	25°C	74°C
"RAISED HAND"	10.0W	12.0W
"WALKING PERSON"	12.0W	15.0W
"COUNTDOWN"	12.0W	15.0W

Sections 825.03 (B) (2), (3), (4), (5), (6), (7), (8), (9), (10), and (11) apply.

**(C) ENVIRONMENTAL REQUIREMENTS**

Section 825.03 (C) (1) and (2) apply.

**(D) COMPONENTS**

Section 825.03 (D) (1), (2), (3), (4), (5), (6), (7), (8) and (9) apply.

**(E) MATERIALS**

Section 825.03 (E) (1), (2), (3), (4) and (5) apply.

**(F) MODULE IDENTIFICATION**

Section 825.03 (F) (1), (2), (3) and (4) apply.

**(G) PHOTOMETRICS**

Section 825.03 (G) (1), (2), (3), (4), (5) and (6) apply.

**825.05 QUALITY ASSURANCE- LIGHT EMITTING DIODE SIGNAL HEADS**

- (1) The modules shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of the modules built to meet this specification, and a documented process of how problems are to be resolved.
- (2) QA process and test results documentation shall be kept on file for a minimum period of seven years.
- (3) LED signal module designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.
- (4) Design Qualification Testing
  - (a) Design Qualification testing shall be performed by the manufacturer or an independent testing lab hired by the manufacturer on new LED module designs, and when a major design change has been implemented on an existing design.
  - (b) A major design change is defined as design change (electrical or physical) which changes any of the performance characteristics of the module, results in a different circuit configuration for the power supply, or changes the layout of the individual LED's in the module
  - (c) A quantity of two units for each design shall be submitted for Design Qualification Testing.

**825.06 CONVENTIONAL POLYCARBONATE PEDESTRIAN SIGNAL HEAD**

- (A) **GENERAL.** The minimum acceptable design and operating requirements for pedestrian signal heads are listed in this section. The pedestrian signal head shall feature two (2)

sections mounted one above the other. Each section shall be capable of accepting a 12 inch LED (Light Emitting Diode) module insert with legends to control pedestrian traffic.

**(B) SIGNAL HEAD HOUSING**

- (1) As a minimum, the signal heads shall meet or exceed the requirements set forth in the latest standard of the Institute of Transportation Engineers (ITE).
- (2) The signal heads shall be constructed from ultraviolet stabilized virgin polycarbonate resin.
- (3) The signal heads shall have a minimum thickness of 0.100 inches.
- (4) The signal head shall feature two (2) sections mounted one above the other with an opening between the two sections capable of accommodating at least three 0.75 diameter cables.
- (5) Unless otherwise specified, the color of the signal head shall be the battleship black, MVC 1417, GE LEXAN Number 70402. This color shall be impregnated throughout the body of the signal head. Federal black may be required in certain specified applications.
- (6) The signal head shall be nominal 12 inch square for both the upper and the lower sections. The upper section will feature the "RAISED HAND" LED insert and the bottom section will feature the "WALKING PERSON" LED insert.
- (7) The upper section of the signal head will feature a terminal block with capacity to accommodate internal and external wires to ensure proper operation. The terminal block shall be capable of securing conductors at least 12 AWG in diameter.
- (8) The signal head shall feature stainless steel hardware, where appropriate.
- (9) The signal head will be equipped with plastic serrated locking rings to enable field installation and connection with metallic upper and lower mounting hardware.
- (10) Each signal head section shall feature a mechanism for attaching the slotted mounting tabs from the tunnel visor.
- (11) Each signal head section shall be manufactured and reinforced to withstand winds up to 80 miles per hour without showing any deflection in the vertical plane or obvious structural failure.
- (12) **PRE-FABRICATION:** Submittal: Prior approval from the District of Columbia is required before signal housings are fabricated. Color chips shall be submitted at least one week prior to the start of the manufacturing process.
- (13) **WARRANTY:** The manufacturer shall warrant the housing to be free from defects in material and workmanship for a period of two (2) years from the date of shipment. Any failure of the device within this period will be repaired by the manufacturer at no cost to the District of Columbia.
- (14) **PERFORMANCE TESTING:** The District of Columbia reserves the right to receive on demand a test report from an independent laboratory certifying that the equipment supplied meets all technical specifications at no cost to the District of Columbia.

(15) **REJECTION:** The District of Columbia reserves the right to reject an entire shipment if ten percent (10%) or more of the devices prove to be defective within 30 days of receipt.

(16) The vehicle signal head shall be capable of being mounted on a span wire, on a pole, on a post top, or on a mast arm.

**(C) SIGNAL HEAD VISORS**

- (1) A signal head visor shall be provided for each section.
- (2) Each visor shall enclose the entire face of the signal section except the bottom. A tunnel visor shall be provided.
- (3) Each visor shall be constructed from ultraviolet stabilized virgin polycarbonate resin.
- (4) Unless otherwise specified, the exterior color of the visor shall be battleship black, as described in Section 2.5. The inside of the visor shall be dull black. A federal black exterior may be required in certain specified applications.
- (5) Each visor shall feature slotted mounting tabs for easy attachment to the signal head housing. Stainless steel screws shall be used to affix the visor to the signal head housing.
- (6) The tunnel visor for each pedestrian signal head section shall be minimum 8 inches long.
- (7) Each pedestrian signal section ordered shall contain two (2) tunnel visors; one to be attached to the housing and the other to be packaged separately with all mounting hardware.

**825.07 CONVENTIONAL POLYCARBONATE VEHICLE SIGNAL HEAD**

(A) **GENERAL.** The minimum acceptable design and operating requirements for 12 inch conventional vehicle signal heads are listed in this section. Each signal head section shall be capable of being joined together to form a vehicle signal head featuring two to five sections. Each section shall be capable of accepting a 12 inch LED (Light Emitting Diode) module insert with legends to control vehicle traffic.

**(B) SIGNAL HEAD HOUSING**

- (1) As a minimum, the signal heads shall meet or exceed the requirements set forth in the latest standard of the Institute of Transportation Engineers (ITE).
- (2) The signal heads shall be constructed from ultraviolet stabilized virgin polycarbonate resin.
- (3) The signal heads shall have a minimum thickness of 0.100 inches.
- (4) Unless otherwise specified, the color of the signal head shall be battleship black, MVCL 14187, GE LEXAN Number 70402. This color shall be impregnated throughout the body of the signal head. Federal black may be required in certain specified applications.

- (5) Each signal head section shall be capable of being joined together to form a vehicle signal head featuring 2 to 5 sections arrayed as defined in the Manual on Uniform Traffic Control Devices (MUTCD). Each signal section shall feature an opening on the top and bottom of the section capable of accommodating at least three 0.75 inch diameter cables.
- (6) Each signal head section shall feature stainless steel hardware, where appropriate.
- (7) A terminal block with capacity to accommodate a minimum of eight (8) wires shall be provided in the middle section of the signal head assembly. The terminal block shall be capable of securing conductors at least 12 AWG in diameter.
- (8) Each section of the signal head shall be manufactured and reinforced to withstand winds up to 80 miles per hour without showing any deflection in the vertical plane or obvious structural failure.
- (9) The signal heads will be equipped with plastic serrated locking rings to enable field installation and connection with metallic upper and lower mounting hardware.
- (10) Each signal head section shall feature a mechanism for attaching the slotted mounting tabs from the tunnel visor.
- (11) Each signal head section shall feature cored holes for back plate mounting.
- (12) **PRE-FABRICATION SUBMITTAL:** Prior approval from the District of Columbia is required before signal housing are fabricated. Color chips shall be submitted at least one week prior to the start of the manufacturing process.
- (13) **WARRANTY:** The manufacturer shall warrant the housing to be free from defects in material and workmanship for a period of two (2) years from the date of shipment. Any failure of the device within this period will be repaired by the manufacturer at no cost to the District of Columbia.
- (14) **PERFORMANCE TESTING:** The District of Columbia reserves the right to receive on demand a test report from an independent laboratory certifying that the equipment supplied meets all technical specifications at no cost to the District of Columbia.
- (15) **REJECTION:** The District of Columbia reserves the right to reject an entire shipment if ten percent (10%) or more of the devices prove to be defective within 30 days of receipt.

**(C) SIGNAL HEAD VISOR**

- (1) A Signal head visor shall provided for each signal section
- (2) Each visor shall enclose the entire face of the signal section except the bottom. A tunnel visor shall be provided.
- (3) Each visor shall be constructed from ultraviolet, stabilized virgin polycarbonate resin.
- (4) Unless otherwise specified, the exterior color of the visor shall be battleship black, as described in 825.07(B)(4). The inside of the visor shall be dull black. A federal black exterior color may be required in certain specified applications.

- (5) Each visor shall feature slotted mounting tables for easy attachment to the signal head housing. Stainless steel screws shall be used to affix the visor to the signal head housing.
- (6) The tunnel visor for each vehicle signal head section shall be a minimum of 10 inches long.
- (7) Each vehicle signal section ordered shall contain two (2) tunnel visors; one to be attached to the housing and the other to be packaged separately with all mounting hardware.

#### **825.08 VEHICLE SIGNAL BACKPLATE**

(A) **GENERAL.** The minimum acceptable design and functional requirements for backplates for vehicle signal heads are listed in this section. Backplates complying to these specifications shall be available for Section 3, 4 Section, and 5 Section 12 inch traffic signal heads in arrays approved by and shown in the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

#### **(B) MATERIAL**

- (1) The backplate shall be manufactured from polycarbonate materials. Specifically, the backplate shall be produced from virgin ABS containing 60% styrene, 20% rubber and 20% acrylic. It shall contain ultraviolet inhibitors and stabilizers for protection against ultraviolet degradation.
- (2) The backplate shall have a minimum thickness of 0.125 inches and must meet a falling dart impact test of 16ft/lb.
- (3) The backplate shall meet or exceed Underwriters Laboratories UL94 Test H.B.
- (4) The backplate shall have a minimum tensile stress of 5300 psi at 73 degrees Fahrenheit.
- (5) The backplate shall be fabricated for cold weather applications. It shall have a haircell finish on one side and a smooth finish on the other side.
- (6) The backplate shall be colored dull black. This color shall be impregnated throughout the entire backplate so as to prevent varying shades and tones.

#### **(C) FABRICATION**

- (1) The backplate shall be one piece, vacuum formed with a haircell finish on the front side. All surfaces shall be flat and straight without blisters, buckling or warping.
- (2) All outside and inside edges shall be formed with a 0.50 to 0.625 inch flange (inside dimension) turned away from the front surface. Flanges shall be straight, uniform and have a consistent flange dimension throughout.
- (3) The backplate shall be designed to fit each manufacturer's vehicle signal head, and it shall be contoured to the signal head to eliminate gaps between the backplate and the signal housing and to allow for attachment to the signal head.
- (4) There shall be a minimum 5 inch border beyond both sides, the top bottom of the signal head. Each exterior corner shall be constructed with a 3 inch radius.

- (5) The finished back plate shall be pre-drilled to fit the vehicle signal head for which it is designated, or it shall contain drill starts for field drilling.
- (6) Each back plate shall be designated to properly fit manufacturer's vehicle signal heads.



## **DIVISION 900 EQUIPMENT**

### **901 GENERAL**

#### **902 EARTHWORK EQUIPMENT**

- 902.01 Tandem Rollers
- 902.02 Tamping or Sheepsfoot Rollers
- 902.03 Pneumatic Tired Rollers
- 902.04 Vibratory Rollers
- 902.05 Tampers
- 902.06 Equipment Identification

#### **903 GENERAL EQUIPMENT**

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- 903.02 Joint Sealer Melting -Applicator Apparatus
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- 904.01 Bituminous Mixing Plants
- 904.02 Trucks for Transporting Bituminous Mixtures
- 904.03 Pressure Distributors
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#### **905 PORTLAND CEMENT CONCRETE EQUIPMENT**

- 905.01 Batch Plants for Portland Cement Concrete
- 905.02 Mixers, Pavers and Delivery Equipment
- 905.03 Forms for Concrete Paving
- 905.04 Grade Templates
- 905.05 Spreading Machines
- 905.06 Concrete Finishing Machines
- 905.07 Vibrators
- 905.08 Membrane Curing Equipment
- 905.09 Hand Tools



**901 GENERAL**

The equipment, as herein specified, is for use under general conditions of construction as included in these specifications.

It is not the intent of these specifications to prohibit the use of equipment that in the opinion of the Chief Engineer would produce a satisfactory construction result.

The Chief Engineer may, therefore, by written permission, allow the Contractor to use new types of improved equipment on a trial basis for evaluation. If the results of the trial are unsatisfactory and the Chief Engineer withdraws his approval, the Contractor will be required to use the original equipment and shall remedy any defective work all at no added expense to the District.

## 902 EARTHWORK EQUIPMENT

### 902.01 TANDEM ROLLERS

All rollers shall be in first-class mechanical condition and shall comply with the specification for the individual items of work.

All tandem rollers shall be power driven, shall at all times be capable of being reversed smoothly and shall be free from backlash, loose-link motion, faulty steering mechanism, worn king bolts and bearings. Any roller that has been improperly weighted or that has in any way been thrown out of its original balance by the application of attachments, not approved or not of the manufacturer's standard design, will not be permitted on any project; nor will any roller that does not have displayed thereon in permanent legible characters, the manufacturer's guaranteed net operating weight as distributed on each axle, be permitted on any project. The net operating weight shall be defined as the actual net weight plus 1/2 the total maximum weight of fuel and water.

### 902.02 TAMPING OR SHEEPSFOOT ROLLERS

Rollers of this type may be either pull type or self-propelled and shall consist of a heavy metal drum with metal studs attached. The ends or tamping feet of the metal studs shall be an acceptable distance from the surface of the drum. The tamping feet shall be of spacing center to center in any direction and of cross-sectional area of each as approved by the Chief Engineer.

Where more than one rolling unit is used, the individual units shall be pivoted to the main frame in such a manner that will permit the rolling units to adapt themselves to uneven surfaces and rotate independently. The minimum weight of the tamping roller under working conditions shall be 90 pounds per inch of drum. The load per tamping foot will be determined by dividing the total weight of roller by the number of tamping feet in one row parallel to the axis of the roller.

The drum shall be watertight and shall be provided with suitable plugs so that it may be weighted with water, sand, or other suitable material to meet the loading requirements.

### 902.03 PNEUMATIC TIRED ROLLERS

Pneumatic tired rollers shall be of a multi-axle, multi-wheel type with smooth-tread pneumatic tires of equal size staggered on the axles at such spacings and overlaps as will provide uniform compactive pressure for the full compacting width of the roller, when operating. Oscillation of the wheels, if provided, shall be in vertical plane only. The pneumatic tired roller shall be capable of (a) being ballasted sufficiently to bring its loaded weight to at least 2-1/2 times its own weight, and (b) exerting compactive ground contact pressures of at least 80 pounds per square inch.

In operation of the pneumatic tired roller, (a) all tires shall be inflated to equal air pressure, within a tolerance of 5 psi, and to the pressure designated for use; (b) the roller shall be ballasted to the extent required or designated; and (c) within limits prescribed above, the roller shall provide the compactive ground pressure per square inch which is most efficient under the conditions and for the purpose of its use, as designated by the Chief Engineer.

The Contractor shall furnish to the Chief Engineer charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of tire loadings for each type and size of compactor tire furnished.

#### **902.04 VIBRATORY ROLLERS**

Vibratory rollers shall be self propelled, have a minimum drum diameter of 48 inches and be capable of developing a minimum frequency of 1600 vibrations per minute. A variable amplitude shall be required with a minimum of 2 settings. The unit static force shall be a minimum 125 pounds per inch with a total applied force of at least 325 pounds per inch. The roller must be equipped so that the vibrating can be turned off before stopping the roller or reversing direction. The rate of travel of roller while vibrating shall be 3 mph.

#### **902.05 TAMPERS**

All tampers of any kind must be of such size that they are capable of producing the specified results. Prior to use they must be approved by the Chief Engineer. If a tamper consistently does not obtain specified results the equipment shall be removed from the job.

- (A) **MECHANICAL TAMPERS.** Vibratory plate tampers shall be capable of exerting a minimum of 3,000 pounds of impact force. The exciter speed shall be a minimum of 4,500 rpm.
- (B) **RAMMERS.** Rammers shall be capable of exerting a minimum of 2,500 pounds of impact force.
- (C) **PNEUMATIC TAMPERS.** Tampers of this type shall be capable of compacting soils materials to the specified density.

#### **902.06 EQUIPMENT IDENTIFICATION**

All compaction equipment shall be marked by a permanently attached manufacturer's identification plate designating the name of the manufacturer, model number and serial number of the machine. This plate shall be installed in a readily visible location. Compaction equipment lacking such an original manufacturer's plate will not be recognized as acceptable compaction equipment.

## 903 GENERAL EQUIPMENT

### 903.01 MILLING MACHINE

The equipment shall be self-propelled with sufficient power, traction and stability to accurately maintain the depth of cut and to remove the pavement thickness to provide the specified profile and cross slope. The equipment shall have an automatic system to maintain the cross slope and control grade elevations by referencing the existing pavement by means of a ski, matching shoe or from an independent grade control. The equipment shall have a loading system or support equipment to completely recover milled material at the removal rate and shall have a means for limiting dust and other particulate matter from escaping the removal operations.

### 903.02 JOINT SEALER MELTING - APPLICATOR APPARATUS

The apparatus for melting and pouring joint-sealing material of the hot-poured type shall be of the double-boiler, indirect heating type. The heat transfer medium shall be a high flash point oil or other material approved by the Chief Engineer. Gasoline, bottled gas, or other approved fuel may be used for heating the oil bath and the heating shall be thermostatically controlled.

The apparatus shall be equipped with an effective mechanically operated agitator and shall have a permanent recording device to indicate the temperature of the joint-sealing material at all times.

The apparatus shall be a melting-applicator combination with means of applying the joint-sealing material under pressure and a means of receiving the cold material without interfering with the dispensing of the melted material.

It is intended that all joint sealing will normally be accomplished with the above described equipment. However, in very special cases where an extremely small amount of material is required, the material may be heated in the melting-applicator apparatus and poured from a double-boiler pouring apparatus if approved by the Chief Engineer. In the event such equipment is approved, it shall be of the indirect, thermostatically controlled heating type capable of maintaining the material at a satisfactory pouring temperature. It shall be equipped with a mechanical or hand operated agitator. A thermometer with a suitable temperature range for determining the temperature of the material shall be provided. Under no circumstances will hand-pouring pots be permitted.

### 903.03 STRAIGHTEDGES

Straightedges shall be 10 feet in length, constructed of a light, durable metal, and have handles securely attached. The straightedge shall not vary more than 1/32 inch in 10 feet from a true plane.

Rolling straightedges with deviation marking abilities may be used upon approval of the Chief Engineer.

**903.04 TELEVISION INSPECTION EQUIPMENT****(A) TELEVISION EQUIPMENT**

Television inspection equipment shall include, at a minimum, the following items:

- (1) A color, sewer television camera, specifically designed for operation through a minimum of 2,000 feet of single conductor cable in sanitary and storm sewers and with the following characteristics/components
  - (a) An outside camera diameter no greater than 3-inches to allow for inspection in small size pipes and an operating temperature range of 0 to 50 degrees C.
  - (b) 320 lines of horizontal resolution and 350 lines of vertical resolution.
  - (c) A solid-state image pickup device containing in excess of 250,000 picture elements (pixels).
  - (d) 525 scanning lines, 60 fields, 30 frames, interlaces 2:1 - NTSC Color Standard, with geometrical image distortion not exceeding two percent (picture transmission systems requiring use of R.F. suppressors and subject to local transmitter interference are not acceptable).
  - (e) Full, true color, sharp image video bandwidths with no sacrifice or visible streaking of low frequency response; also no visible streaking of the low frequency test bars when viewing a standard EIA Test Chart.
  - (f) A 1.0V (140 IRE units) composite camera video signal at the monitor after transmission through 2,000 feet of single conductor cable.
  - (g) Equipped with an f/1.4 wide angle lens with optical viewing angle to 70 degrees, auto iris type to control the illumination range for an acceptable picture between 10 and 100,000 Lux, with manual override remotely controlled from the viewing station.
- (2) A minimum of 1,000 linear feet of cable to transmit picture from camera to recording and viewing unit.
- (3) A videocassette recorder capable of slow motion playback without noise bars.
- (4) Video cassettes documenting the entire television inspection with 1/2 inch wide tape, ninety (90) minutes duration maximum, "data view" indicating project address identification, and date and voice description of sewer inspected during video recording.
- (5) An on-board television viewing monitor consisting of a high quality, industrial grade color unit providing in excess of 500 lines of resolution.
  - (a) A high-resolution "Trinitron" type picture tube or approved equivalent, measuring a minimum of 12 inches diagonally.
  - (b) The inclusion of voltage compensation circuits to reduce picture distortion to less than one percent under voltage conditions varying from 105V to 120V.

- (c) A steel cabinet housing that acts as a shield to minimize effects of local magnetic fields such as transformers, coils, wraps of cable, etc. (monitors having inadequate or no protection from local magnetic fields, thereby contributing to loss of color picture purity, are not acceptable).
- (d) Speaker-equipped to allow for audio playback from video tape recording.

#### **(B) LIGHTING EQUIPMENT**

The halogen lighting system shall be comprised of controlled-beam, reflector-sealed lamps with an automatic light compensator. The lighting system shall be capable of supplying variable light of high intensity.

#### **(C) CAMERA TRANSPORT**

Portable, mutual winches or motorized mechanical equipment of indirect drive type shall be provided, complete with sufficient cable or rods to permit inspection of all sewer sections specified and capable of moving the camera through the sewer pipe in either direction at a uniform, slow rate.

#### **(D) METERING DEVICE**

A remote-reading, footage metering device(s) shall be provided such that the camera location at ground level is visually displayed at all times on the television screen. A footage metering device shall be designed so that the distance recorder can be set at zero when camera is at the entrance of the pipe. The metering device shall have an accuracy of +/- 1% actual distance between manholes. Marking of cable or similar means that require interpolation of depth of sewer will not be permitted. A measuring target in front of the television camera shall be an exact measurement reference point, and the meter reading shall show the exact location of the reference point.

#### **(E) MONITOR TRAILER**

A lighted trailer or other suitable shelter, complete with table and chairs, shall be provided for observation of the television monitor and record keeping. Trailers shall be large enough to accommodate at least three people at any time for the purpose of viewing the monitor while TV inspection is in progress.

#### **(F) ACCESSORIES**

Accessory items shall include barricades, ladders, pulleys and safety equipment.

## 904 BITUMINOUS EQUIPMENT

### 904.01 BITUMINOUS MIXING PLANTS

- (A) **GENERAL.** Plants used for the preparation of hot mix bituminous mixtures shall be a batch, continuous or drum type. The plant shall be approved prior to use and conform to the appropriate sections of AASHTO M 156.

The plant shall be of sufficient capacity to adequately handle the proposed construction and be maintained in good mechanical condition. Any defects that adversely affect the proper function of the plant or the quality of the mixture shall be repaired immediately.

The plant shall be equipped with all necessary scales, measures and weighing devices to insure proper proportioning of all ingredients and shall be so designed, coordinated and operated to produce a mixture within the job mix tolerances. Testing and checking these weighing devices and meters shall be done in the presence of the Chief Engineer.

The plant shall be equipped with a laboratory in accordance with 106.06.

All moving parts, pulleys, belts and drive mechanisms shall be covered or otherwise protected. Stairways and platforms shall be unobstructed and have secure handrails. Particles shall be controlled within the requirements of Environmental Protection Agency. Dust collectors are required. Bag-house fines, when used, shall be re-circulated to the mineral filler bin.

- (B) **SCREENING.** In batch plants, the aggregates, immediately after heating, shall be screened into 3 or more fractions and conveyed into separate compartments. In any compartment there shall be not more than 5 percent of the aggregate larger than the screen controlling the top size of the material nor more than 20 percent smaller than the screen size controlling the smallest material for the particular separation. When continuous mixing plants are used, a minimum of three aggregate cold feed bins shall be used to proportion aggregates to obtain the specified gradation.
- (C) **SURGE AND STORAGE BINS.** The Contractor may elect to store hot mixed bituminous concrete in a surge or storage bin provided said bin has received prior evaluation and approval by the Chief Engineer. Use of the bin is to be in conformance with all limitations on retention time, type of mixture, heater operation, bin atmosphere, bin level or other characteristics set forth in the applicable specifications. Affixed to each bin and visible from the Inspector's office and to the loading operator shall be an indicator device that will be activated when the material in the bin drops below the top of the sloped portion of the bin.

An evaluation of a surge or storage unit will determine the degree of composition uniformity, temperature characteristics and the degree of asphalt cement hardening of mixture processed through the surge or storage unit. Approval will be granted for bin usage that consistently results in mixtures having gradation and temperature properties of no less quality than specified mixtures discharged directly from the plant's mixing operation and resulting in asphalt hardening properties which do not exceed the limits specified below. Materials for use as open graded coarse material should not be stored

because of the likelihood of asphalt migration. Mixtures that the Chief Engineer determines visually to be segregated will be rejected.

Asphalt hardening due to storage shall not exceed 10 per cent of the original values determined from the asphalt prior to mixing.

Original asphalt properties shall be determined from samples of asphalt taken prior to incorporation into the mix. Test procedures shall be in accordance with AASHTO M 20 or M 226, whichever is applicable as determined by the Chief Engineer.

The amount of hardening due to storage shall be determined by comparison of tests on samples of the mixtures taken after exit from the pug mill or drum but before entry into the storage bin and before samples are taken after exit from the storage bin.

When asphalt hardening, due to mixing, exceeds the amount allowed for original asphalt by AASHTO M 20 or M 226, whichever is applicable, use of a bin for other than as a surge bin will not be permitted unless storage can be determined to have no significant effect on asphalt hardening.

Recovery of asphalt from the mixture shall be in accordance with AASHTO T 164 and T 170.

The system shall be capable of conveying the hot mix from the plant to the storage bins and storing the hot-mix without a loss in temperature, segregation of the mix or oxidation of the mix.

Storage and surge bins shall be designed in such a manner as to prevent segregation of the hot-mix during discharge from the conveyor into the bins and shall be equipped with discharge gates that will not cause segregation of the hot- mix while loading the mix into the trucks.

#### **904.02 TRUCKS FOR TRANSPORTING BITUMINOUS MIXTURES**

Trucks for transporting bituminous mixtures shall have a solid metal, dump type bed. The bed shall be free of debris, clean, smooth and have a tight fitting rear gate to prevent loss of materials while in transit.

The inside surface of the bed shall be sprayed with an approved material shall be used to prevent the mix from adhering to the beds. Petroleum derivatives or other coating material that contaminate or alter the characteristics of the mix will not be approved nor will excessive quantities of approved oil be permitted.

Each truck shall be equipped with a canvas or other suitable material of sufficient size to cover the material and protect it from the weather. When necessary to maintain temperature, the truck bodies shall be insulated to prevent temperature loss while in transit. The trucks shall not have appreciable oil leakage that may cause damage to the new bituminous construction.

A hole 1/4 to 1/2 inch in diameter shall be provided in the truck bed at an appropriate height to facilitate the insertion of an asphalt thermometer.

All trucks shall be equipped with a back-up alarm meeting D.C. safety code.

### 904.03 PRESSURE DISTRIBUTORS

Distributors used for the application of bituminous materials shall be of the pressure type mounted on trucks or semi-trailers equipped with pneumatic tires. The tires shall have sufficient width of rubber in contact with the prepared road surface to avoid breaking the bond or forming a rut in the surface. The rear axles of semi-trailer units shall be mounted on dual wheels.

The distributor shall be equipped with a suitable means to provide a uniform temperature of the entire mass of material. The heating unit shall be designed to heat the bituminous material without burning or overheating any portion and with effective and positive control of the heat at all times. The distributor shall be provided with at least one thermometer that shall be maintained in good condition at all times and placed to register accurately the temperature of the tank content.

The distributor shall be constructed and operated to be capable of evenly and uniformly applying accurately measured quantities from 0.05 to 1 gallon of bituminous material per square yard of surface. The specified rate of application shall be maintained during the distribution of the entire load regardless of change in grade or direction.

The spray bar and nozzle shall be of such size to insure uniform distribution of the material in specified quantities, and the nozzles shall be designed to issue a fan-shaped spray without streaks or bare spots. A strainer shall be provided in the discharge line to prevent the nozzles from becoming clogged.

The distributor shall be equipped with a tachometer that will show the speed in feet per minute. It shall be located as to be easily visible to the truck driver to enable him to maintain the constant speed necessary for the correct application of the specified quantity of material.

A pressure gauge shall be provided to indicate accurately the pressure at which the bituminous material is applied. If an air-pressure type distributor is used, the air relief valve shall be discharging at all times during the distributing operations. All distributors, except those of the air-pressure type, shall be equipped with auxiliary motors for pumping material to the spray bars.

The distributor shall be designed so that the application of bituminous material can be started and stopped instantly at all nozzles without dribbling and without the driver leaving his seat. It shall have sufficient pressure to provide a spray that will cover completely and uniformly the entire surface receiving the application.

A hand spray bar and nozzle attachment capable of operating under the required pressure and that can be gaged shall be provided with the distributor. It shall consist of a suitable length of flexible steel hose with packed couplings and will be used for touching up spots inaccessible to or unavoidably missed by the distributor.

### 904.04 BITUMINOUS PAVERS

Bituminous pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thicknesses shown on the plans. The pavers shall be equipped with

adjustments of the manufacturer's standard design that will permit the bituminous material to be spread and finished in widths shown on the plans. The machine shall be capable of placing a minimum width of 8 feet.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The paver shall be equipped with automatic feed controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

The screed or strike off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

All pavers shall be equipped with automatic screed controls with sensors for either or both sides of the paver, capable of sensing grade from an outside reference line, sensing the transverse slope of the screed and providing the automatic signals that operate the screed to maintain the desired grade and transverse slope. The sensor shall be constructed to operate from a reference line or a ski-like arrangement.

The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

Manual operation may be permitted by the Chief Engineer for the construction of irregularly shaped small areas.

Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods for the remainder of the normal working day on which the breakdown or malfunction occurred provided this method of operation will produce results meeting specifications.

Reference lines will be required for both outer edges of the traveled way for each main line roadway for vertical control. Horizontal control utilizing the reference line will be permitted. The grade and slope for intermediate lanes shall be controlled automatically from reference lines or by means of a ski and a slope control device or a dual ski arrangement. When the finish of the grade prepared for paving is superior to the established tolerance and when, in the opinion of the Chief Engineer, further improvement to the line, grade, cross sections, and smoothness can best be achieved without the use of the reference line, a ski-like arrangement may be substituted subject to the continued approval of the Chief Engineer. The use of the reference lines shall be reinstated immediately whenever the Contractor fails to maintain a superior pavement. The Contractor shall furnish and install all pins, brackets, tensioning devices, wire and accessories necessary for satisfactory operation of the automatic control equipment.

#### **904.05 ASPHALT ROLLERS**

Rollers shall be self-propelled, reversible and steel wheeled or pneumatic tired. Rollers may be vibratory or non-vibratory, and they may be operated in the vibratory mode as long as the Chief Engineer determines that the roller is not cracking or damaging the aggregate in the mix. Rollers shall not be used in the vibratory mode on bridge decks. Pneumatic tired rollers shall have multiple tires of equal size with smooth tread. Tires shall be uniformly inflated at the

operating pressure approved by the Chief Engineer. The Contractor shall furnish the Chief Engineer with charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of tire loadings for each type and size of compactor furnished. Rollers shall be operated according to the recommendation of the manufacturer.

#### **904.06 HAND TOOLS FOR FINISHING ASPHALT SURFACES**

- (A) **ASPHALT LUTE.** The asphalt lute shall be of aluminum or wood with a rigid blade 3 to 6 feet in length and 6 inches in width. The blade shall be edged on the contact surface. The handle, to one end of which the blade shall be firmly affixed with adequate bracing, shall be 16 feet in length.
- (B) **RAKES.** Rakes shall be made of metal and shall be not less than 14 inches wide. The tines shall be of sufficient depth to penetrate and rake the material for its full depth.
- (C) **SMOOTHING IRONS.** Smoothing irons shall be made of metal and shall weigh not less than 40 pounds. The bearing surface shall be not less than 80 square inches.
- (D) **HAND TAMPERS.** Hand tampers for compaction of bituminous material in locations inaccessible to rollers shall be of metal construction, weigh not less than 25 pounds and shall have tamping face of not less than 48 square inches.

## 905 PORTLAND CEMENT CONCRETE EQUIPMENT

### 905.01 BATCH PLANTS FOR PORTLAND CEMENT CONCRETE

- (A) **GENERAL.** Batch plants shall meet requirements of AASHTO M 157. Before starting deliveries, the plant from which the Contractor proposes to obtain materials shall be approved by the Chief Engineer. The batching plant for Portland Cement Concrete shall include bins for either the stationary or portable type, with adequate separate compartments for cement, cement substitutes, fine aggregates and for each size of coarse aggregate. Each compartment shall be designed to discharge efficiently and freely into the weighing hopper or hoppers. The plant shall be equipped with a laboratory in accordance with 106.06.

The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. Particles shall be controlled within EPA requirements. The batch plant shall be equipped with a suitable non-re-settable batch counter that will correctly indicate the number of batches proportioned.

All batching plant structures shall be properly leveled within the accuracy required by the weighing mechanism design.

- (B) **BINS AND HOPPERS.** Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batch plant.

Hoppers shall be constructed so as to eliminate accumulation of tare materials and to fully discharge without jarring the scales.

All hoppers, except cement hoppers, shall have a means of removing an overload of any one of the several materials.

Partitions of sufficient size to prevent spilling under working conditions shall separate the cement and aggregates in the weighing bins and in the hoppers.

- (C) **SCALES.** The scales for weighing aggregates and cement shall conform to the requirements of 109.01 and the following requirements. When beam-type scales are used, the provision such as a "tell-tale" dial shall be made for indicating to the operator that the required load in the weighing hopper is being approached. A device on weighing beams shall indicate critical position clearly. The weighing beam and "tell-tale" device shall be in full view of the operator while charging the hopper and the operator shall have convenient access to all controls.

Graduated dials shall be provided with suitable markers, inside the glass cover and in front of the dial that may be set to indicate the position of the dial indicator for predetermined loads in the weighing hopper.

The hopper and scales shall be suitably enclosed to protect against the influence of wind.

Ten 50 pound standard test weights shall be provided at each batch plant for testing weighing equipment.

The scales shall be maintained within a tolerance of 0.5 percent of the net load in the hopper. The minimum graduation on the beam or dial shall not be greater than 0.2 percent

of the rated capacity of the scales. All cement handling, weighing and batching apparatus shall be protected from the weather.

Clearance between scale parts, hoppers and bin structures shall be such as to avoid displacement of or friction between parts due to accumulations, vibration or other causes. Pivot mountings shall be designed so none of the parts will loosen and to assure constant spacing of knife edges under all circumstances. Scales shall be designed so that all exposed fulcrums clevises and similar working parts may be readily cleaned. The weighing mechanism of the scales shall be constructed of non-corrosive materials and of hardness greater than brass. Weighing beams shall have leveling lugs, and weighing parts of other types shall be provided with means for precision adjustment. Scales shall be inspected, calibrated and properly sealed at the expense of the Contractor when required by the Chief Engineer.

- (D) **AUTOMATIC WEIGHING DEVICES.** Batching plants shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices of an approved type.
- (E) **WATER MEASURING EQUIPMENT.** The accuracy of the water measuring equipment shall be within 1.5 percent error. The measurement shall not be affected by variations of pressure in the water supply line and shall be accurate under all construction conditions encountered. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to check the setting unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be equal to or greater than that of the measuring tank.

#### **905.02 MIXERS, PAVERS AND DELIVERY EQUIPMENT**

- (A) **TRUCK MIXERS AND AGITATORS.** Truck mixers and agitator trucks shall meet the requirements of AASHTO M 157 for Ready-Mixed Concrete and be equipped with a back-up alarm meeting the D.C. Safety Code. Each truck shall be numbered in a permanent, readily visible manner. Each mixer and agitator shall have attached to it a metal plate or plates on which is marked the capacity of the drum or container in terms of the volume of mixed concrete for the various uses for which the equipment is designed and the speed of rotation of the mixing drum or blades.
- (B) **CENTRAL PLANT.** The mixer shall be of an approved design of the batch type and have a rated capacity of not less than 27 cubic feet of mixed concrete. The mixer shall be capable of combining the aggregates, cement and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging the mixture without segregation. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, providing that each batch is mixed in 90 seconds. The mixer

shall be equipped with a suitable batch counter which shall correctly indicate the number of batches mixed.

The mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 1/4 inch or more. The Contractor shall (1) have available at the job site a copy of the manufacturer's design showing dimensions and arrangements of blades in reference to original height and depth, or (2) provide permanent marks on blade to show points of 1/4 inch wear from new conditions. Drilled holes of 1/4 inch diameter near each end and at midpoint of each blade are recommended.

- (C) **NONAGITATOR TRUCKS.** Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight, metal containers (non-aluminum) and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. Concrete shall be discharged from the bottom of the container. Covers shall be provided when needed for protection.
- (D) **PAVING MIXER.** The concrete paving mixer shall be of an approved design of not less than 27 cubic feet and equipped with boom and bucket delivery. The bucket shall be so constructed that it will distribute the concrete on the base course material in a uniform and satisfactory manner. The mixer shall be equipped with a batch meter and an approved timing device that will automatically lock the discharge lever during the full time of mixing and release it at the end of the mixing period. This device shall be equipped with a bell adjusted to ring each time the lock is released.

Pick-up and throw-over blades in the drum of the mixer shall be replaced when they have lost 10 percent of their depth and shall be repaired or replaced when broken or cracked to such an extent as to interfere with the mixing of the concrete. The drum shall be kept clean and free from accumulation of concrete at all times.

The skip of the mixer shall be of such capacity to contain the materials dumped into it without spillage. The drum of the mixer shall be loaded in such a manner as to avoid the loss of any part of the batch due to spilling.

The auxiliary heater of the side arm type with BTU capacity for maintaining continuous water temperature of 70° F or more as required to maintain proper concrete temperatures shall be included as a part of the stationary mixer.

The manufacturer's maximum normal rated capacity shall be clearly indicated on a plate fixed to the mixer machine. No drum shall be loaded in excess of the maximum rated capacity as indicated on this plate.

### 905.03 FORMS FOR CONCRETE PAVING

- (A) **PAVEMENT, BASE AND ALLEY FORMS.** Straight side forms shall be made of a metal having a thickness of not less than 7/32 inches and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth equal to the prescribed edge thickness of the concrete, without horizontal joint, and a base width equal to the depth of the forms. Forms shall be provided with adequate devices for the secure setting so that when in place they will withstand the operation of the paving equipment. Flange braces shall extend outward on the base not less than 2/3 the height of the form. Forms with a

battered top surface, and bent, twisted or broken forms shall be removed. Repaired forms shall not be used until inspected and approved. Built-up forms shall not be used except where the total area of pavement of any specified thickness on the project is less than 2,000 square yards. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch. The forms shall contain provision for locking the ends of abutting form sections together tightly and for secure setting.

- (B) CURB, GUTTER, CURB AND GUTTER AND SHOULDER FORMS.** Forms for this work shall meet the requirements of (A) above with the following exceptions, changes or additions.

Forms for Portland Cement Concrete curb shall be of a depth equal to the depth of the curb. The face form shall have a batter of 1/2 inch from the top of the curb to the flow line of the gutter.

Back forms for combination curb and gutter shall be of a depth equal to the combined depth of the curb and gutter. The forms for the face of the curb and the face of the gutter shall be a depth equal to the depth of the curb and gutter respectively. The face form of the curb portion shall have a batter of 1/2 inch from the top of the curb to the flow line of the gutter and shall be so designed that it may be securely attached to the back form. When so attached, it shall be of such rigidity as to maintain a true line when concrete is placed against it.

Forms for curb, the face forms for combination curb and gutter, and the back forms for combination curb and gutter will not be required to have a base width equal to or greater than the depth of the form nor will flange braces be required; however, other means for bracing will be required.

Forms of curb, gutter, curb and gutter or shoulder, that have attachments or plates of any type that create planes of weakness at other than the specified intervals will not be permitted.

- (C) SIDEWALK FORMS.** Sidewalk forms shall conform to the requirements of (A) above except that the steel shall be not less than 10 gauge in thickness; the requirements pertaining to base width/face depth relation and the requirements for flange braces need not apply. Only 2 stake pockets will be required for each 10 feet of form; however, fabrication of the forms shall be such that they will withstand handling and remain true to line and grade under construction conditions.

#### **905.04 GRADE TEMPLATES**

Templates for checking final grades of the base course material shall be rigidly constructed and shall be of such length as to span, from form to form, the section to be tested. The template shall be adjustable to the crown desired and shall be provided with shoes to ride the top of the forms without variation from the desired elevation. Adjustable tines of equal length and spaced at 6 inch intervals shall be attached to the bottom and aligned throughout the entire length of the template.

**905.05 SPREADING MACHINES**

The concrete spreading machine shall be power driven and capable of spreading the concrete to the full width and depth specified. It shall have multiple speeds in both reverse and forward gears.

The apparatus shall be capable of spreading the concrete to both the depth specified for reinforcement and the full thickness of the slab without segregation and without interfering with the joints or reinforcement. It shall not disturb the form due to lateral pressure of the spreading operation, and the weight of the machine shall not cause settlement of the forms.

The spreader shall be equipped with traction wheels with dismountable rims to be used when operating on concrete. Suitable means shall be provided to keep material off the wheels and the top of the forms or slab.

The spreading shall be accomplished by a suitable device of the reversing type, followed by a strike-off screed. The strike-off screed shall be adjustable to the specified crown and section.

**905.06 CONCRETE FINISHING MACHINES**

(A) **ROADWAY.** The concrete-finishing machine shall be power driven and of the transverse-screed type. It shall be equipped with traction a wheel or wheels with dismountable rims to be used when operating on concrete. Suitable means shall be provided to keep material off the wheels and the top of the forms or slab.

The finishing machine shall be equipped with 2 oscillating type transverse screeds that shall be maintained in the best possible condition and adjustment throughout their use. The front screed shall be used for striking off excess concrete to exact grade and crown.

The rear screed shall be used for finishing and smoothing. All screeds shall be constructed of steel, capable of being adjusted to the specified cross section and shall be of such rigidity as to produce the specified crown and cross section.

Each screed shall be of the floating or suspended type and at least one and one-half feet longer than the width between the forms. They shall be easily and quickly adjustable to the width required.

Both the machine and the screeds shall have variable speeds and be independently controlled. The weight of the machine shall not cause settlement of the forms upon which it operates.

Bridge Deck Finishing Machines should not be used on pavements greater than 7 inches in depth.

(B) **BRIDGE DECK FINISHING MACHINES.** The specific method and equipment that the Contractor proposes to use will be subject to the approval of the Chief Engineer. Approval of method and equipment will not relieve the Contractor of full responsibility for obtaining the required finished surface.

The concrete finishing machine shall be hydraulically driven, capable of variable traveling speeds in both forward and reverse directions. The machine shall have a rotating auger and cylinder device that shall oscillate in the transverse direction for leveling and finishing concrete. The auger shall be 8 to 12 inches in diameter and shall be capable of

leveling the concrete to the approximate finished grade. The cylinder shall have the same diameter as the auger and shall be approximately 4 feet long. The cylinder shall be capable of consolidating the surface and screeding to the final finished grade while traveling in one transverse direction and finishing while traveling in the opposite direction. A pan- type vibrator shall be mounted directly ahead of the auger to insure final compaction of any surface voids caused by workers after initial vibration. A steel float pan shall be mounted directly behind the cylinder and shall be capable of imparting a final seal to the concrete.

The machine carriage shall be fully adjustable. The machine shall be capable of being adjusted in the vertical direction to within 1/16 inch of the elevation and cross section shown on the plans, including parabolic and straight crowns. The machine shall be capable of being adjusted to any width from 12 feet to the full width of the bridge deck. The machine shall be capable of automatically widening or narrowing to finish tapered deck areas. The machine shall be kept in true adjustment. Machines out of adjustment shall not be used until proper adjustments have been made and the adjustments approved by the Chief Engineer.

- (C) **COMBINATION MACHINES.** Machines that have both spreading and finishing capabilities shall conform to both requirements of 905.05 and 905.06(A). When two screeds are not provided by a combination machine, the Chief Engineer will require that a minimum of two passes with the same machine be made to provide adequate floating and consolidation.

#### 905.07 VIBRATORS

- (A) **MOUNTED.** Vibrators for full width vibration of concrete paving slabs shall be the internal type with either immersed tube of multiple spuds. They may be attached to the spreader or the finishing machine or may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer devices, base course material or side forms. The frequency of the surface vibrators shall not be less than 3,500 impulses per minute, and the frequency of the internal type shall not be less than 7,000 impulses per minute for spud vibrators.

When spud type internal vibrators, attached to spreaders or finishing machines, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

- (B) **HAND HELD.** Internal vibrators, such as the spud type, for compacting concrete at joints and manholes shall be of an approved type and shall operate at a frequency capable of producing at least 5,000 impulses per minute. They shall not be of such weight as to be unwieldy in application and shall have sufficient cable to permit movement to any location by the Chief Engineer.

#### 905.08 MEMBRANE CURING EQUIPMENT

- (A) **PAVEMENT WIDTHS OF 9 FEET OR MORE.** For pavement widths 9 feet or more, membrane curing, if used, shall be applied by equipment meeting the following requirements:

The equipment shall be an approved, self-propelled, mechanical pressured sprayer delivering a fine, even spray with uniform coverage and shall be operated upon the pavement forms. A suitable shield or apron shall be provided to effectively protect the spray from the wind. Sufficient nozzles shall be on hand at all times so that any inefficient nozzle can be immediately replaced. Suitable means of cleaning and repairing the nozzles shall also be on hand and shall be considered as being part of the spraying equipment.

- (B) PAVEMENT LESS THAN 9 FEET WIDE.** For pavement widths less than 9 feet, for sidewalks, curb and gutter, or irregular shapes, the equipment used to apply membrane curing compound may be equipped with a container having not less than 5 gallons in which a constant pressure shall be maintained by a mechanical means. The equipment does not have to be self-propelled.

### 905.09 HAND TOOLS

- (A) HAND STRIKE-OFF SCREEDS.** Hand screeds for striking off concrete prior to final finishing shall be made of metal or metal shod wood construction with convenient handles for even operation. The length shall measure 4 feet greater than the slab upon which it is used. The screed shall weigh not less than 15 pounds per linear foot and shall be of such rigid construction that it will not reduce the crown of the slab nor disturb the center longitudinal joint because of any sag in the midsection.
- (B) EDGING TOOLS.** Edging tools for use on finished concrete shall be made of metal and be 2-1/2 inches in width. They shall have radii of 1/4, 1/2, 3/4 or 1 inch as required.
- (C) FLOATS.** The small hand float used to finish the pavement surfaces adjacent to the curb shall be made of wood and be at least 12 inches in length.

The float used to finish concrete pavement shall be 8 inches in width and a minimum of 4 feet in length. The minimum length of attached handle shall be 16 feet and at least 4 feet longer than the width of the slab on which it is used.

**(D) BROOMS.**

- (1) FOR USE ON PAVEMENT SURFACES.** The brooms used to produce a roughened surface on the Portland Cement Concrete pavement shall be street brooms with split bamboo bristles or metal-bristle brooms made especially for this purpose. The length of the broom handle shall be at least 1/2 the slab width and the broom width shall not be less than 14 inches.
- (2) FOR USE ON SIDEWALK SURFACE.** Brooms used for finishing sidewalk surfaces shall be of the hair or bristle type, and shall be not less than 14 inches in width. Nylon brooms shall not be permitted.
- (E) HAIR BRUSHES.** Brushes used for finishing concrete curb shall be of the hair or bristle type. Nylon brushes shall not be permitted.
- (F) METAL TINES.** For texturing concrete surfaces on bridge decks, metal tines shall be 0.03 inches thick, 0.08 inches wide and four to six inches in length. Average transverse groove spacing shall be approximately 1/2 inch. Broom shall be a minimum of 18 inches wide.

## **APPENDIX**

### **PAVEMENT SMOOTHNESS SPECIFICATION**

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## APPENDIX I. PAVEMENT RIDE QUALITY

### 1. DESCRIPTION

This special provision describes pavement surface smoothness construction and quality control, using the International Roughness Index (IRI), for concrete and asphalt paved surfaces. It includes incentives and disincentives. The Contractor shall use an inertial profiler or rolling inclinometer to collect Quality Control (QC) data on pavement ride quality. The profiler shall conform to ASTM E 950 and DDOT Equipment Specification and Test Method for Ride Quality Data Collection.

This work shall consist of:

- Furnishing and operating a certified profiler to measure ride quality according to the International Roughness Index (IRI).
- Maintaining the profiler in calibration and good working order.
- Providing a certified profiler operator.
- Preparing and submitting a Ride Quality Measurement Plan and, if required, a corrective action plan to the Engineer for acceptance.
- Ensuring that the pavement on which ride quality measurements are taken is sufficiently clean prior to ride quality measurements.
- Performing all ride quality measurements as required by this special provision.
- Completing all corrective action.

This special provision supersedes the longitudinal tolerances specified in subsection *401.14, Surface Tolerances*, of the Standard Specifications for Construction, with the exception as noted in Section 3. Subsections *501.13 (F), Surface Correction*, and *501.16, Surface Testing*, of the Standard Specification for Construction shall remain in force.

### 2. RELATED STANDARDS

#### 2.1 AASHTO Standards

- PP 37-04, Determination of International Roughness Index (IRI) to Quantify Roughness of Pavements
- PP 49-03, Certification of Inertial Profiling Systems
- PP 50-03, Operating Inertial Profilers and Evaluating Pavement Profiles
- PP 51-03, Pavement Ride Quality When Measured Using Inertial Profiling Systems
- MP 11-03, Inertial Profiler

#### 2.2 ASTM Standards

- ASTM E 950-98, Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference

- ASTM E 1926-98, Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile

### 2.3 DDOT Standards

- DDOT Equipment Specification and Test Method for Ride Quality Data Collection
- Subsection 401.14, Surface Tolerances
- Subsection 501.13 (F), Surface Correction
- Subsection 501.16, Surface Testing

## 3. TERMINOLOGY

Defect Segment – Any 25-foot segment with measured IRI greater than the IRI threshold for defect penalty/correction (IRI<sub>p</sub>) (section 9.4(b)).

Contractor Quality Control Measurement of Ride Quality -- Informational run(s) made by the Contractor to determine the ride quality acceptability, the need for corrective action, or the need for a process change. It can also include runs made after corrective action to determine if corrective action has been sufficient.

Correction Segment – Any 25-foot segment with measured IRI greater than the IRI threshold for defect correction (IRI<sub>c</sub>) (section 9.4(b)).

International Roughness Index (IRI) – A statistic used to determine the amount of roughness in a measured longitudinal profile. Computer programs to calculate the IRI statistic from a longitudinal profile are referenced in AASHTO PP 37-00.

Predetermined Exempt Areas – Pavement within the project where this Pavement Ride Quality special provision does not apply, but straightedge requirements of subsection 401.14 or 501.16 of the Standard Specifications will be in force as applicable. Predetermined exempt areas include:

- Ramps other than freeway-to-freeway ramps
- All ramp tapers
- Shoulders
- Drainage grates in the wheelpath
- Railroad crossings and pavement within 50 feet thereof
- Bridges – The predetermined exempt area is that area between the two end reference lines or between the outermost limits of any structure expansion joint devices and pavement within 50 feet thereof
- Brick crosswalks.
- Bus pads (unless constructed by the same contractor)

Profile – The elevation of a pavement surface along a line parallel to the centerline of the pavement. Also defined as a two-dimensional plot of the elevation of a pavement surface, taken in a longitudinal direction. Profiles are measured separately along each wheelpath of a lane.

Profiler – In general, a device that measures the elevation of a pavement surface and creates a profile. In particular, a device that meets the requirements of DDOT Equipment Specification and Test Method.

Project Feature Areas – The 25-ft segments associated with pavement features such as manholes and intersections. The IRI values from these segments are not included in computing the section IRI<sub>AVG</sub>. However, they are used to determine defect costs and correction areas.

Ride Quality Certification – A formal process required by the Department to assure that ride quality measuring equipment and operators are capable of measuring ride quality to the standards established in DDOT Equipment Specification and Test Method. The equipment shall display the equipment certification sticker indicating the expiration date of certification. The operator shall provide a copy of the operator certification to the Engineer.

Ride Quality Measurement Area – The local, collector, and arterial roadways, freeway-to-freeway ramps, and other areas as shown on the project plans.

Run of Record – The formal ride quality measurement submitted by the Contractor that includes all data files associated with the profile run, IRI values for every 25 foot segment, and the IRI<sub>AVG</sub> (section 8.1) value for the submittals listed in section 8.3.1. A Run of Record is measured in the direction of travel. Each Run of Record must be labeled using a format approved by the Engineer.

Quality Assurance Run – A ride quality measurement made by the Engineer on a project, or portion of a project, to determine the ride quality. A verification run is conducted and the quality assurance (QA) results are compared to the Contractor Run of Record on the same pavement area to determine if the Contractor's entire Run of Record may be used as part of the acceptance decision.

Test Lot – A continuous segment of roadway as defined by the street name, direction, lane number, and from and to stations. Profile measurement shall be performed and recorded for each individual test lot as *Run of Record*.

Verification Limit – The allowable variation between the QA and the quality control (QC) data. This limit accounts for the expected variability of ride quality measurements taken by the same operator using the same piece of equipment on the same test lot. The Verification Limit is defined in section 6.2 of this specification.

Wheelpath – The longitudinal locations 33 to 35 inches on either side of the centerline of each lane. The spacing between the right and the left wheelpath shall be between 67 and 70 inches, especially near roadway features such as manholes.

#### 4. RIDE QUALITY MEASUREMENT PLAN

A QC Ride Quality Measurement Plan shall be submitted to the Engineer for review at least 14 calendar days before the start of paving operations for major construction projects, as determined by the Engineer. For minor construction projects, a QC Ride Quality Measurement Plan shall be submitted to the Engineer for review at **least 7 calendar days** before the start of paving operations. Do not begin paving operations before receiving written acceptance from the Engineer. All paved lanes shall be tested

for smoothness. All exempted areas shall be documented as to the location and reason for exemption in all data reports submitted to the engineer in charge. The Engineer will notify the Contractor of any objections to the plan within 5 calendar days of receipt of the plan.

Include the following minimum requirement details in the Ride Quality Measurement Plan:

- Equipment used to measure ride quality on the project.
- Equipment certification or verification records for profiling equipment scheduled to be used in the QC measurements. This should include more than one device (additional one as backup) and should include the certification agency, certifying agency contact information, certification number, and expiration date.
- A signed statement shall be provided that no changes to the profiling system have been made since the certification.
- Certification records for any operator that might conduct the QC measurements. The records should include the certifying agency contact information and the operator(s) certification expiration date(s).
- Planned locations for profile run of record data collection
- Planned length of the profile run of record data collection
- Traffic control plans for ride quality measurement (as required)
- Planned method(s) to correct surface irregularities, when necessary
- Ride quality testing and reporting time frames in relation to paving and staging operations
- Feature labeling format description and other relevant notes for the run of record

## 5. GENERAL RIDE QUALITY MEASUREMENT REQUIREMENTS

Testing procedures, equipment, operators, and reporting shall be in accordance with DDOT Equipment Specification and Test Method for Ride Quality Data Collection. Notify the Engineer at least 24 hours before measuring a profile Run of Record or performing any pavement corrections.

## 6. RIDE QUALITY DETERMINATION

### 6.1 Units of Measurement

Calculate and report ride quality as International Roughness Index (IRI) in units of inches/mile.

### 6.2 Calculation Method

Calculate and report an IRI value, according to ASTM E 1926, for the left and right wheelpath of each 25-foot segment of the project. Compute the  $IRI_{AVG}$  from each run as the average IRI from both wheelpaths for all 25-ft segments that do not contain features. A run is defined as a day's product, or a pre-determined test lot length no longer than 1 mile, as approved by the DDOT representative.

Report all ride quality values rounded down to the nearest whole number. Segments shorter than 25 feet (due to exempt areas or the project end) shall be ignored. A full 25-foot segment shall be started after each exempt area. Segments less than 25 ft that precede exempt areas shall not be included in the  $IRI_{AVG}$  calculations.

### 6.3 Correction Method

When the IRI of any 25-foot segment ( $IRI_{25}$ ) is greater than the IRI threshold for defect penalty/correction ( $IRI_e$ , see section 9.4(b)), that segment is deemed *defective*, and one of the following corrective actions shall be taken, as directed and approved by the Engineer. The Contractor shall take corrective action(s) at no additional cost to the Department.

#### 6.3.1 Actions for Segments with $IRI_e < IRI_{25} \leq IRI_f$

- For hot mix asphalt (HMA) pavement, remove and replace a minimum of 1½ inches of HMA one full lane width wide for the defective segments, or
- For Portland cement concrete (PCC) pavement, grind the segment to bring the segment IRI into conformance with these specifications, i.e.  $IRI_{25} < IRI_e$ , or
- For either HMA or PCC pavements, accept the Defect Cost (Pdefect.) for any defect segment where corrective action is not performed. This is applicable only when the IRI of any 25-foot segment is within the IRI threshold for defects correction ( $IRI_f$ ) (section 9.4(b)).

One of these corrective actions shall be applied to each defective segment as directed by the Engineer. Any approval from the Engineer to waive action 1 or 2 shall not constitute a waiver of action No. 3 unless explicitly stated in writing by the Engineer. The Contractor shall re-profile all the corrected segments and 50 feet of length before and after each corrected segment. The re-profiled data shall be used for pay calculations regarding defect segments.

#### 6.3.2 Actions for Segments with $IRI_{25} > IRI_f$

- For hot mix asphalt (HMA) pavement, remove and replace a minimum of 1½ inches of HMA one full lane width wide for the defective segments, or
- For either HMA or Portland cement concrete (PCC) pavement, grind the segment to bring the segment IRI into conformance with these specifications, i.e.  $IRI_{25} < IRI_e$ .

One of these corrective actions shall be applied to each defective segment as directed by the Engineer. The Contractor shall re-profile all the corrected segments and 50 feet of length before and after each corrected segment. The re-profiled data shall be used for pay calculations regarding defect segments.

If the resulting  $IRI_{25}$  is still greater than  $IRI_f$ , after corrective action was applied, with DDOT Engineer’s approval, the contractor may accept the Failed Segment cost ( $P_{failed}$ , section 9.4(d)).

**7. RIDE QUALITY MEASUREMENT VERIFICATION**

**7.1 General**

At DDOT’s discretion, DDOT may perform QA testing on sections of the pavement to verify the Contractor’s QC data. If the QA testing by DDOT has not been performed within 14 calendar days from the date that the final, 100 percent QC data submittal is received by the Engineer, the QC data shall be used for pay adjustments on the project, if any.

Testing procedures, equipment, operators, and reporting of the QA profile testing shall be in accordance with the requirements set forth in this specification, as well as the DDOT Equipment Specification and Test Method for Ride Quality Data Collection, with the following exception:

If the first QA run, along with the QC data, meets the criteria specified in section 7.2.1 below, then no additional QA profile runs are required. Otherwise, the Department will carry out a total of three QA runs on all 25-foot segments of the project. The coefficient of variation of the QA  $IRI_{AVG}$  for the entire project should be less than or equal to 5 percent for all three runs. When the three QA runs do not meet this criterion, additional three runs shall be performed until three measured QA runs meet this criterion. The QA run that yields the median  $IRI_{AVG}$  value shall be used as the QA results.

**7.2 Verification Limit**

*7.2.1 QC data acceptance*

The QA and QC results will be compared to determine acceptance of the Contractor’s QC data. For each test lot, the verification limit for  $IRI_{AVG}$ , the number of defective segments, and the number of tested segments are as follows:

PARAMETER	UNIT	QC DATA TOLERANCE WITH RESPECT TO QA DATA
$IRI_{AVG}$	Inches/mile	± (5 %)
Number of Defective Segment	25-ft Segments	± (10 %)
Number of Tested Segments	25-ft Segments	Same

If the Contractor’s QC data fall within all the above tolerances, the Contractor’s QC data shall be used for all pay adjustments.

*7.2.2 QC data resolution*

When the Contractor’s QC data do not agree with the initial DDOT QA data as described above, both profilers shall be retested on a DDOT

verification section to determine if either profiler does not conform to DDOT Specification.

If either profiler is out of specification, that equipment shall be recalibrated or repaired as necessary, and it shall be retested to bring the device back into compliance with DDOT Spec. When the Contractor's out of specification profiler is not re-standardized and brought into compliance with DDOT Equipment Specification and Test Method within three paving days, the Contractor shall cease paving operations or use another standardized profiler for QC data collection. Once the Contractor's profiler complies with DDOT Equipment Specification and Test Method, the Contractor may retest sections for comparison with DDOT's data or accept the DDOT QA data as the basis for any pay adjustment on all sections.

If only DDOT's profiler is out of specification, the Contractor's QC data for all sections will be accepted, from the point the conflict arose until DDOT profiler is brought to compliance. When both profilers are found to be in noncompliance with DDOT Equipment Specification and Test Method, both profilers shall be repaired or recalibrated as necessary, and all QC and QA testing since the previous QC/QA comparison shall be repeated.

## 8. MEASUREMENT AND REPORTING

The contractor shall compute and report the IRI average and 25-ft feature area segment IRI values as define below.

### 8.1 IRI<sub>AVG</sub>

The IRI<sub>AVG</sub> (overall average IRI for the project) shall be calculated as the average of the left and right wheelpath IRI value of all tested 25-foot segments on the project, with the following exceptions. The IRI values for the 25-foot feature area segments (section 8.2) shall not be used to compute IRI<sub>AVG</sub>.

### 8.2 Feature 25-foot segments excluded while computing IRI<sub>AVG</sub> for the project

The IRI values from the following 25-foot feature area segments shall not be included in computing the section IRI<sub>AVG</sub>. They will, however, be used to determine the defect costs as well as correction area, as described in section 9.

- Pavement within 25 feet of the transverse joints that separate these joints from the existing pavement. Note that the last segment before the end of the project may be a partial segment (i.e. a length less than 25 feet). This does not apply when a transverse joint is paved on both sides as part of one contract.
- Segments with manholes or other approved roadway features (whose edges are within 1 foot of the wheelpath).
- If a feature is identified within 2.5 feet of the bordering segment, the bordering segment shall also be labeled as a feature segment.
- Major at-grade intersections with part width or staged construction (where

traffic flow is maintained during construction) may be considered for exclusion from IRIAVG computation. In such cases, the excluded area shall extend 25 feet on either side of the intersection.

**8.3 Quality control reporting**

*8.3.1 Submittal timing requirements*

Results of QC testing shall be submitted to the DDOT Engineer in conformance with the following schedule:

Submittal	Percentage of paving completed <sup>1</sup>	Reporting time limit <sup>2</sup>
Field	Any	On the day of testing
First	10 %	Within 72 hr of completion
Interim	50 %	Within 72 hr of completion
Draft Final	100 %	Within 72 hr of completion
Re-profiled data for corrected segments	ALL	Within 72 hr of completion

<sup>1</sup> The percentage of all pavement requiring profiling that has been paved. Areas not required to be profiled are not considered in the percentage computation.

<sup>2</sup> Completion is defined as opening to traffic following paving or corrections for HMA pavement and curing sufficiently to support traffic following paving or corrections for PCC pavement. Official 25-ft segment IRI values must be submitted immediately following data collection.

When any profile testing and data submission has not been completed within the specified times and in conformance with draft DDOT YYYY Equipment Specification and Test Method and DDOT Ride Quality Specification for all segments on the project, the tested pavement will not be eligible for incentive payment as stated in section 9.

When any profile testing and data submission has not been completed within 7 days and in conformance with DDOT Equipment Specification and Test Method and DDOT Ride Quality Specification for all segments on the project, the tested pavement will not be eligible for payment.

*8.3.2 Submittal information requirements*

The contractor shall submit the data and reports according to both the DDOT Equipment Specification and Test Method, and the schedule defined in 8.3.1.

**9. PAYMENT**

All costs associated with ride quality measurements, including all measurements required for construction and final acceptance, are included in Other Items of Work

and will not be paid for separately. All corrections within the limits of ride quality shall be carried out at the Contractor's expense.

### 9.1 Pay Adjustments

Incentive, full pay, and disincentive pay adjustments for the project shall be computed according to the following methods. Descriptions of the abbreviations used in these computations are included in table 1.

Table 1. Factors used in payment computations.

	DESCRIPTION	VALUE	UNITS
$P_{max}$	Maximum Incentive for Overall IRI	+	Percent
$P_{min}$	Maximum Disincentive for Overall IRI	+	Percent
$P_{defect}$	Defect Segment Cost	+	Percent
$P_{failed}$	Failed Segment Cost	+	Percent
PF	Pay Adjustment Factor for Overall IRI	*	Percent
INCENTIVE	Incentive for Overall IRI	*	Dollars
DISINCENTIVE	Disincentive for Overall IRI	*	Dollars
DEFECT COST	Cost for Defects	*	Dollars
FAILURE COST	Cost for Failures	*	Dollars
$IRI_a$	Threshold $IRI_{AVG}$ for Maximum Incentive	+	Inches per mile
$IRI_b$	Minimum $IRI_{AVG}$ for Full Pay	+	Inches per mile
$IRI_c$	Maximum $IRI_{AVG}$ for Full Pay	+	Inches per mile
$IRI_d$	Threshold $IRI_{AVG}$ for Maximum Disincentive	+	Inches per mile
$IRI_e$	$IRI_{25}$ threshold for Defects correction/penalty	+	Inches per mile
$IRI_f$	$IRI_{25}$ threshold for Defects correction	+	Inches per mile
$IRI_{AVG}$	Overall average IRI for the project, excluding 25-foot feature segments	*	Inches per mile
$IRI_{25}$	IRI for individual 25-foot segments	*	Inches per mile
$NS_{nonfeat}$	Number of tested 25-foot non-feature segments	*	Segments
$NS_{feat}$	Number of tested 25-foot feature segments	*	Segments
$NS_{TT}$	Number of ALL tested 25-foot segments: $NS_{TT} = NS_{nonfeat} + NS_{feat}$	*	Segments
$NS_{defect}$	Number of 25-foot defect segments	*	Segments
$NS_{failed}$	Number of the failed 25-foot defect segments	*	Segments

BP <sub>Lot</sub>	Bid price of the entire test lot	*	Dollars
BP <sub>seg</sub>	Bid price of each 25-foot segment	*	Dollars
TPA	Total Pay Adjustment	*	Dollars

- \* Value to be determined on the test lot or contract.
- + The ride specification limits for P<sub>max</sub>, P<sub>min</sub>, P<sub>defect</sub>, P<sub>failed</sub>, IRI<sub>a</sub>, IRI<sub>b</sub>, IRI<sub>c</sub>, IRI<sub>d</sub>, and IRI<sub>e</sub> for roadways will be determined by the Engineer in conformance with this specification.

**(a) Incentive**

PF = P<sub>max</sub>, when IRI<sub>AVG</sub> is less than or equal to IRI<sub>a</sub>  
 PF = P<sub>max</sub> x (IRI<sub>b</sub> - IRI<sub>AVG</sub>) / (IRI<sub>b</sub> - IRI<sub>a</sub>), when IRI<sub>AVG</sub> is greater than IRI<sub>a</sub> and less than IRI<sub>b</sub>

INCENTIVE = PF x NS<sub>nonfeat</sub> \* BP<sub>seg</sub>  
 DISINCENTIVE = 0

**(b) Full Pay**

When IRI<sub>AVG</sub> is greater than or equal to IRI<sub>b</sub> and less than or equal to IRI<sub>c</sub>

INCENTIVE = 0  
 DISINCENTIVE = 0

**(c) Disincentive**

PF = P<sub>min</sub> x (IRI<sub>AVG</sub> - IRI<sub>c</sub>) / (IRI<sub>d</sub> - IRI<sub>c</sub>), when IRI<sub>AVG</sub> is greater than IRI<sub>c</sub> and less than IRI<sub>d</sub>  
 PF = P<sub>min</sub>, when IRI<sub>AVG</sub> is greater than or equal to IRI<sub>d</sub>

INCENTIVE = 0  
 DISINCENTIVE = PF x NS<sub>nonfeat</sub> \* BP<sub>seg</sub>

**9.2 Defects**

A separate deduction will be assessed for all 25-foot segments within the project with IRI<sub>25</sub> levels greater than the defect level. The pay adjustment for defects (Defect Cost) shall be calculated based on the factors shown below. This pay adjustment applies only to the pavement within the tested segments, including the feature area 25-foot segments, but not including the predetermined exempt areas.

**(a) Defect Cost**

NS<sub>defect</sub> = Number of segments with an IRI<sub>25</sub> greater than or equal to IRI<sub>e</sub> and less than IRI<sub>f</sub>

DEFECT COST = P<sub>defect</sub> x NS<sub>defect</sub> x BP<sub>seg</sub>

**(b) Correction Required**

Segments with an IRI<sub>25</sub> greater than or equal to IRI<sub>f</sub> will need to be corrected to reach an IRI<sub>25</sub> that is less than IRI<sub>f</sub> as defined in section 6.3.

**(c) Failure Cost**

$NS_{\text{failed}}$  = Number of segments with an  $IRI_{25}$  greater than or equal to  $IRI_f$  and not able to be corrected.

$$\text{FAILURE COST} = P_{\text{failed}} \times NS_{\text{failed}} \times BP_{\text{seg}}$$

**9.3 Total Pay Adjustment**

The Total Pay Adjustment (TPA) for pavement surface profile on the Contract shall be the total of any incentive or disincentive for overall IRI minus any cost for defects.

$$\text{TPA} = (\text{INCENTIVE} - \text{DISINCENTIVE} - \text{DEFECT COST} - \text{FAILURE COST})$$

This Total Pay Adjustment shall be subject to conditions (a) and (b) below:

- (a) Regardless of the measured profile of any test section, incentive payments shall not be permitted for the project when the Contractor’s QC data were not submitted within 14 days of the scheduled submittal date. All other sections of this specification shall still apply. In this case, the Total Pay Adjustment is calculated as follows:

$$\text{TPA} = (0 - \text{DISINCENTIVE} - \text{DEFECT COST} - \text{FAILURE COST})$$

- (b) The total value of Overall IRI Disincentive and Defect Cost shall not be more than the Maximum Disincentive pay adjustment (section 9.4c) for all of the profiled 25-foot segments.

$$\text{Max. Disincentive} = - P_{\text{min}} \times NS_{\text{TT}} \times BP_{\text{seg}}$$

If TPA is negative and smaller than Max. Disincentive, then  $\text{TPA} = \text{Max. Disincentive}$ .

**9.4 Pay Limit Determination**

The pay limits and levels will be determined in conformance with the following tables.

**(a) Select specification limits for  $IRI_a$ ,  $IRI_b$ ,  $IRI_c$  &  $IRI_d$**

Functional Class	$IRI_a$ (in/mi)	$IRI_b$ (in/mi)	$IRI_c$ (in/mi)	$IRI_d$ (in/mi)
Interstates, Freeways/Expressways, and Principal Arterials with Posted Speed Limit $\geq 45$ mph	40	60	80	100
Principal Arterials with Posted Speed Limit $< 45$ mph; Minor Arterials, and Collectors	80	130	160	200
Local Roads	100	160	180	220

**Note:**  $IRI_a$  – Threshold  $IRI_{AVG}$  for Maximum Incentive;  $IRI_b$  – Minimum  $IRI_{AVG}$  for Full Pay;  $IRI_c$  – Maximum  $IRI_{AVG}$  for Full Pay;  $IRI_d$  – Threshold  $IRI_{AVG}$  for Maximum Disincentive.

**(b) Select defect threshold for correction/penalty ( $IRI_c$ ) and only correction ( $IRI_f$ )**

Functional Class	$IRI_c$ (in/mi)	$IRI_f$ (in/mi)
Interstates, Freeways/Expressways, and Principal Arterials with Posted Speed Limit $\geq 45$ mph	120	160
Principal Arterials with Posted Speed Limit $< 45$ mph; Minor Arterials, and Collectors	250	300
Local Roads	300	350

**Note:**  $IRI_c$  –  $IRI_{25}$  threshold for Defects correction/penalty;  $IRI_f$  –  $IRI_{25}$  threshold for Defects correction.

**(c) Select the appropriate pay level for  $IRI_{AVG}$**

Functional Class	Maximum incentive ( $P_{max}$ in % of total cost)	Maximum disincentive ( $P_{min}$ in % of total cost)
Interstates, Freeways/Expressways, and Principal Arterials with Posted Speed Limit $\geq 45$ mph	3%	2%
Principal Arterials with Posted Speed Limit $< 45$ mph; Minor Arterials, and Collectors	1.5%	1%
Local Roads	1.2%	0.8%

**(d) Select the appropriate pay level for defective and failed segments**

Functional Class	Defect Segment Cost ( $P_{defect}$ in % of segment cost)	Failed Segment Cost ( $P_{failed}$ in % of segment cost)
Interstates, Freeways/Expressways, and Principal Arterials with Posted Speed Limit $\geq 45$ mph	15%	60%
Principal Arterials with Posted Speed Limit $< 45$ mph; Minor Arterials, and Collectors	12%	50%
Local Roads	10%	40%

## **B. EQUIPMENT SPECIFICATION AND TEST METHOD FOR RIDE QUALITY DATA COLLECTION**

### **1. SCOPE**

This specification defines the required attributes of a high-speed inertial profiling system, lightweight inertial profiling system or a rolling inclinometer profiling system used to measure longitudinal pavement profiles for construction quality control and acceptance. The system shall be able to measure and record pavement surface profiles, calculate International Roughness Index (IRI), flag roadway features such as manholes and intersections, and provide other features necessary to meet DDOT pavement smoothness quality control specifications.

### **2. RELATED STANDARDS**

#### **2.1 AASHTO Standards**

- PP 37-04, Determination of International Roughness Index (IRI) to Quantify Roughness of Pavements
- PP 49-03, Certification of Inertial Profiling Systems
- PP 50-03, Operating Inertial Profilers and Evaluating Pavement Profiles
- PP 51-03, Pavement Ride Quality When Measured Using Inertial Profiling Systems
- MP 11-03, Inertial Profiler

#### **2.2 ASTM Standards**

- ASTM E 950-98, Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference
- ASTM E 1926-98, Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements

#### **2.3 DDOT Standards**

- Draft DDOT XXXX, Special Provision For Pavement Ride Quality
- Subsection 401.14, Surface Tolerances
- Subsection 501.13 (F), Surface Correction
- Subsection 501.16, Surface Testing

### **3. TERMINOLOGY**

**Accelerometer:** transducer that provides an output proportional to vertical acceleration.

**Aliasing:** the error that can result when a signal is sampled at a rate less than twice the frequency of the various sinusoidal components that compose the signal. It is also

described as the error that results from sampling a long wavelength signal that is mixed with a short wavelength noise signal.

Anti-aliasing filter: a low-pass filter that suppresses short wavelength contamination of longer wavelength measurements to improve the accuracy of the sampling process.

Filtering: a procedure to extract desired information from a signal that also contains unwanted information (commonly called noise). Digital filtering is a calculation procedure that takes one set of numbers and transforms them into another set in which the noise is reduced. Moving averages are one type of such transform or filter.

High-pass filter: reduces the effect of long wavelengths that are associated with gradual elevation changes such as hills.

Index: measure or standard. Within the context of this test method, a suitably chosen index quantifying the ride quality of a pavement.

Infrared laser sensor: non-contacting transducer that provides an output proportional to the distance from the sensor to a reflecting surface. These sensors are mounted at a nominal height, or standoff distance, above the roadway surface when the test vehicle is in a static position.

Low-pass filter: smoothing type filter that reduces the effect of short wavelengths that are associated with rapid elevation changes such as expansion joint ribs.

Measurement range: the detectable range of heights measurable by the laser sensor.

Moving average: filtering process whereby each data point is replaced with the average value of several adjacent points or elevations. It is a smoothing process because the changes from one elevation point to the next will not be as significant because the difference has been divided by the total number of data points in the averaging scheme. It is a type of low-pass filter.

Profile: two-dimensional slice of the roadway surface taken along an imaginary line, such as the wheelpath, in the longitudinal or travel direction. It represents the perpendicular deviations of the pavement surface from an established reference parallel to the horizontal.

Reference line: the imaginary line formed by the infrared laser sensor and the accelerometer in a static mode.

Repeatability: consistency in successive measurements of the same quantity over time. It is a quantifier of the variability in measurement error.

Reporting interval: the travel distance between the outputs of a profile elevation or index value.

Reproducibility: the ability of two independent measurement systems to accurately, and with precision, measure and record a known or fixed value.

Roughness: according to ASTM E 867, the deviation of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics and ride quality.

Run of Record: The formal ride quality measurement submitted by the Contractor that includes all data files associated with the profile run, IRI values for every 25 foot

segment, and the IRIAVG (section 8.1) value for the submittals listed in section 8.3.1. A Run of Record is measured in the direction of travel. Each Run of Record must be labeled using a format approved by the Engineer.

Running interval: set travel distance that is stepped through a test segment by an increment shorter than its length.

Sampling or sample interval: the longitudinal distance between data capture points. The data includes location, height, and accelerometer values. These data points are combined to create one profile data point. These points may be averaged to create a final value on the reported profile.

Sampling rate: the rate at which the height sensor measures vertical displacement. This sampling rate and the vehicle operating speed determine the sample interval.

Sensors: devices that measure physical quantities. They are responsive to changes in a physical measurement such as distance, temperature, and acceleration.

Standoff distance: the distance from the light source to a point in the center of the measurement range.

Test Lot: A continuous segment of roadway as defined by the street name, direction, lane number, and from and to stations. Profile measurement shall be performed and recorded for each individual test lot as Run of Record.

Transducer: device that converts variables of one type (i.e., voltage) into those of another type (e.g., distance). These conversions must conform to a known transformation (i.e., are proportional) to be useful.

## 4. GENERAL SYSTEM REQUIREMENTS

### 4.1 General

The high-speed and lightweight inertial profiling systems shall meet the general system requirements of AASHTO MP-11 with the following additions and modifications:

### 4.2 Measuring Profiles

- The profiling system shall satisfy the following conditions: collect accurate profile data at testing speeds ranging from 10 to 30 mi/hr for lightweight profilers, 15 to 70 mi/hr for high-speed profilers, and up to 2.4 mi/hr for a rolling inclinometer; collect accurate profile data on pavements having roughness values (IRI's) that range from 5 in/mi to 400 in/mi, and collect accurate profile data on asphalt surfaced, surface treated (chip seal) and non-longitudinally grooved, tined, or ground portland cement concrete surfaces. The profile data shall not be affected by pavement markings that are traversed by the sensors. The collected profile data shall not be affected by pavement color, texture, or ambient lighting.
- The triggering system shall be capable of repeatability within  $\pm 3$  in over the range of operating speeds. Manual triggering is allowed for the rolling inclinometer.

- The system shall be capable of accurately collecting surface profile wavelengths from 2 in to 300 ft when operated between 10 and 70 mi/hr for the high-speed profilers, 10 to 30 mi/hr for the low-speed profilers, and up to 2.4 mi/hr for a rolling inclinometer.
- The system shall be capable of determining a profile value (sampling interval) every 1 in or less with a recording interval of no more than 2 in at the maximum collection speed of the vehicle.

#### 4.3 Calculating Roughness Indices

The system shall compute International Roughness Index (IRI) in real time at 25-ft intervals.

#### 4.4 Calibration

- Calibration of the distance and acceleration sensors and checks of the height sensors shall be easily and quickly achievable using the equipment and software provided by the manufacturer.
- The hardware required for checking the calibration of the height sensors, such as leveling plates and gage blocks, and/or other calibration devices shall be provided with each profiler.

### 5. EQUIPMENT REQUIREMENTS

#### 5.1 General

The high-speed and lightweight inertial profiling system shall meet the equipment requirements of AASHTO MP-11 with the following additions and modifications.

#### 5.2 Functional Hardware Modules

- Initiation control – The inertial profiler shall be capable of initiating data collection with manual initiation by striking a key on the computer keyboard or provided event marker board or by using an automated photo-triggering device. The procedure used shall be user selectable, with the automated method being the default and the manual method being the secondary option. A mechanism for automatically initiating profile measurements shall be mounted on the front bumper of the vehicle. The photo-triggering device shall be mounted to a protected case that can be swiveled to face the pavement surface or to the side of the roadway. The operator shall be able to select one of the following methods to initiate data collection: (1) the mechanism shall be triggered by reflective highway marking tape that is placed on the middle of the travel lane or (2) by tape on a cone or other device that is placed adjacent to the test lane at distances up to 10 ft from the outside lane edge. Manual initiation of the rolling inclinometer is allowed.
- Event marker system – The event marker system shall allow the operator to mark measurement limits using both the photocell and reflective cones or manual triggering. The event marker system shall also allow the operator to mark feature locations through manual triggering.

- Distance transducer –A DMI display unit shall be placed at a position that is easily visible to the operator. The DMI shall be capable of automatically displaying distance and system speed in either English or SI (metric) units, as selected by the operator. In addition, the running DMI stationing shall be displayed on the inertial profiler computer monitor during data collection. The measured distance using this system shall be accurate to at least  $\pm 0.1$  percent. Accuracy of the rolling inclinometer transducer shall be  $\pm 0.25$  percent or below.
- Height sensor – The inertial profiler reference height of the vehicle above the pavement shall be obtained through a laser module as required. The laser should be equivalent to a Selcom laser, which has a resolution of 0.002 inches. The laser shall have a measurement range of at least 7.5 in and provide continuous coverage of the roadway at up to 65 mi/hr. Each height sensor shall be mounted on the vehicle with its measuring axis perpendicular to the traveled surface and in line with the sensitive axis of the accelerometer. The height sensor shall be mounted such that the center of the measurement range is at the surface of the pavement when the vehicle is at rest. The spacing between the right and the left sensors shall be between 67 and 70 inches. No laser height sensors are required with the rolling inclinometer.
- Inclinometer sensor – The inclinometer sensors shall provide the profile and IRI accuracy required in section 6.
- Vertical acceleration sensor –The accelerometers used to measure the vertical acceleration shall be of high quality, capable of measuring accelerations in the range of  $\pm 5g$ . The accelerometer shall have a resolution of at least 5 micro-g, and a bandwidth of at least 150 Hz. The accelerometer shall be biased to account for 1g acceleration of gravity and capable of being quickly calibrated using a 1g signal. The accelerometer shall be mounted such that its sensitive axis is perpendicular to the traveled surface. No accelerometers are required with the rolling inclinometer.

### 5.3 Functional Software Modules

- Calibration software – Calibration software that will perform calibration of the accelerometer, inclinometer, and distance measuring system (DMI) and calibration checks on the height sensors. Calibration software shall be menu driven and complete, not requiring manual adjustment to any system component. Calibration constants shall be automatically computed. At the operator's request, a new calibration constant shall replace the previous inaccurate constant, and the old constant shall be recorded in a log file along with the time, date, and operator's comments, if feasible.
- Accelerometer calibration software – The inertial profiler accelerometers shall have internal or external calibration features. After calibration, a measure of the accelerometer's error and the computed calibration factor shall be displayed on the computer monitor. The software shall be capable of replacing the inaccurate constant with the new calibration constant at the operator's keyboard command, and recording the old constant in a log file along with the time, date, and operator's comments, if feasible.

- Distance measuring software – The distance measuring system shall be capable of being calibrateded by measuring a predetermined distance on a straight section of roadway. The distance measuring system shall be capable of calibration at measuring speeds that will be used for profiling. The inertial profiler calibration software shall be capable of detecting two marks that are at a known distance apart with the aid of a photocell. These two marks may be placed on the pavement surface (e.g., white pavement marking tape or reflective tape) or on the shoulder of the pavement (e.g., cones with reflective markings). Manual triggering is allowed for the rolling inclinometer. The system software shall be capable of recording the distance traveled between the two specified marks to three decimal places in meters. The software shall be capable of automatically computing the calibration constant based on the actual distance between these two markings. At the operator's keyboard command, the new calibration constant shall replace the inaccurate constant and the old constant shall be recorded in a log file along with the time, date, and operator's comments, if feasible. The DMI calibration software shall be capable of indicating whether the measurements obtained on the section are within a user-defined tolerance limit.
- The system shall output profile elevation data in ERD format that is immediately readable by the current FHWA ProVAL software.
- The system shall have an alarm system that alerts the operator if speed or height signals are out of range.

## 6. SYSTEM ACCURACY REQUIREMENTS

### 6.1 General Component Requirements

- Profile accuracy – The profile precision of lightweight and high-speed inertial profilers shall be confirmed at least yearly by an independent review, and shall meet the AASHTO PP 49 point-to-point requirements. AASHTO PP 49 requires no more than  $\pm 20$  mils for 10 repeated measurements sampled at intervals 2 in or less. Equipment profile bias shall meet the AASTHO PP 49 point-to-point requirements that allow a maximum deviation of the average elevations from 10 runs versus the average of 3 reference profile runs to be no more than  $\pm 60$  mils.
- IRI Ride Statistic accuracy – The IRI precision of the lightweight profilers shall be confirmed by the Pennsylvania DOT certification program. PA DOT requires single sensor IRI standard deviation of five repeat runs to be within  $\pm 3$  percent on the PA DOT test tracks. PA DOT also requires the mean wheelpath IRI values, based on the five repeat runs, to be within  $\pm 5$  percent of the reference wheelpath IRI value. They use a long wavelength cutoff of 100 ft for analysis. High speed profiler and rolling inclinometer IRI accuracy using a 300-ft long wavelength cutoff shall be confirmed in the DDOT profiler verification program under section 6.2.2.
- Distance measurement accuracy – The inertial profiler distance measuring instrument accuracy shall be measured in accordance with AASHTO PP 49 over a 1,000-ft test site. The distance obtained from the distance measuring

system shall be capable of satisfying the following criteria over a reference distance of 1,000 ft ( $\pm 3$  in) over the range of equipment's operating speeds. Three runs over a distance of 1,000 ft are required to verify the distance measurement accuracy. Accuracy of the average value within  $\pm 1$  ft per 1,000 ft is required.

## 6.2 Equipment Certification or Accuracy Verification

Profile equipment shall either be certified in accordance with section 6.2.1, or verified in accordance with section 6.2.2.

### 6.2.1 Equipment Certification

Annual certification is required for the lightweight profiler equipment. Additional recertification may be required for equipment due to repairs, replacement, and/or upgrades to the equipment's hardware or software, or questionable results on a construction or maintenance project. Certification obtained for lightweight profilers in the following manner will be recognized by the agency:

- From a state agency that has a DDOT approved equipment and operator certification program based on AASHTO PP 49 criteria; or
- Certification carried out by The Bureau of Maintenance and Operations, Roadway Management Division, Pennsylvania Department of Transportation, in accordance with the *Light Weight Profiling System Calibration Verification & Operator Certification Program Manual and Pennsylvania Test Method (PTM) # 428, Method of Test for Measuring Pavement Profile Using A Light Weight Profiler*.

### 6.2.2 Equipment Accuracy Verification

- Verification Testing Requirement Verification of the equipment profiles and indices shall be completed at least annually, within the same construction season, prior to any QC or QA testing using high-speed or lightweight profilers or rolling inclinometers. The same construction season is defined as from March to November of any calendar year. DDOT verification shall include collecting profile and IRI data from a DDOT approved reference test section. The results of this testing shall be submitted to DDOT for review. Upon approval, the equipment can be used for QC/QA testing. A copy of the DDOT approval document shall be included with the results of all QC or QA testing.
- Reference Site Description – DDOT will maintain at least two baseline profile testing sites during the paving season, within or outside the District. One will allow for low-speed, off-road testing and the other will allow for high-speed testing. These sites shall be 1,000 ( $\pm 0.25$ ) ft long, straight, on a grade less than 1 percent, and with minimal variation in the transverse pavement profile. The pavement surfaces shall be asphalt that is in good condition with IRI values no more than 135 in/mi. The lightweight inertial profiler off-

road test site shall allow test speeds of 15 and 30 mph. The high-speed profiler test site shall allow test speeds of 45 to 55 mph without traffic control. Rolling inclinometers shall be used at 0.1 to 2.4 mi/hr.

- Reference Site Baseline Testing – DDOT will conduct reference testing for these sections in the first weeks of March and July of each year, weather permitting. Reference testing shall include the collection of three profiles in each wheelpath using an approved, calibrated rolling inclinometer with a sampling interval of 1.0 in and high accuracy in wavelengths from 2 inches to at least 300 feet. During the March testing, the reference profiles shall be checked and adjusted using high accuracy rod and level measurements at 50-ft intervals. The accuracy of the site length will also be confirmed during the March testing.
- Verification Testing – This shall include collecting three sets of profiles from both wheelpaths, at both of the verification test sites. These profiles shall be filtered using a 300-ft high-pass filter and the manufacturer’s recommended low-pass filters. If needed, traffic control and associated permits must be provided and obtained by the contractor for such testing. The contractor shall also ensure that the Verification Test site is clean of debris for profile testing purpose.
- Verification Test Reporting – Contractors shall submit to DDOT profiler field printouts of left and right wheelpath IRI values at 25-ft intervals beginning at the start of the test site. Profiler provider shall submit electronic copies on CD of their verification profile data to DDOT within 7 days of verification testing in approved ERD format. Paper reports shall be submitted at the same time that include, at a minimum, the following information:
  - Section information – List the verification test site number and location.
  - Testing date and conditions – List the testing date and times and average air temperature.
  - Calibration Confirmation Form – A signed Profiler Calibration Form, as shown in Attachment A, list the results of all pretesting calibration activities.
  - Filter settings – Note the long and short wavelength cutoff values.
  - Software version – List the software version used for collecting and processing the profile data.
  - Sampling and recording intervals – List the sampling and reporting intervals used in data collection.
  - Profile printouts – Print and include the profiles from each run and wheelpath.
  - IRI Summary Data – List the overall IRI values (in/mi) for each

run and wheelpath on the verification site. Also list the IRI average and standard deviation for each wheelpath.

- IRI Detail Data – List the 25-ft IRI values (in/mi) for each run and wheelpath of the verification test site. Also include IRI average and standard deviation values for each 25-ft segment.
- Verification Testing Acceptance – DDOT will review the precision and bias of the submitted IRI values. Evaluation results will be provided in writing within 7 working days of submittal. DDOT will evaluate the overall IRI values to ensure that the mean of the three runs is within 5 percent of the reference average IRI. DDOT will also ensure that the coefficient of variation (standard deviation/mean) of the overall IRI in each wheelpath is no more than 3 percent.

### 6.3 Operator Certification

The profiler operators are required to be certified, and must be recertified a minimum of every 3 years. Certification obtained for the profiler operators in the following manner will be recognized by the agency:

- From a state agency that has a DDOT approved equipment and operator certification program based on AASHTO PP 49 criteria; or
- Certification carried out by The Bureau of Maintenance and Operations, Roadway Management Division, Pennsylvania Department of Transportation, in accordance with the *Light Weight Profiling System Calibration Verification & Operator Certification Program Manual* and *Pennsylvania Test Method (PTM) # 428, Method of Test for Measuring Pavement Profile Using A Light Weight Profiler*.

## 7. TESTING PROCEDURE

Quality control and quality assurance testing shall include the following procedures and any additional manufacturer's recommendations that are not in conflict with these specifications. In addition, ride quality testing shall be consistent with the Ride Quality Measurement Plan as defined in DDOT Ride Quality Specification.

### 7.1 Project test area setup

- Boundary marking – Mark on the pavement surface with temporary marking paint the beginning and end of the area to be tested, designated by the project stationing, the words "Begin" or "End," and a test date, e.g., 9/16/2007. Mark on the pavement the boundaries of all exempt areas, as defined in DDOT Ride Quality Specification.
- Feature location identification and wheelpath marking – It is strongly recommended that each roadway feature be identified before testing, and that a reflective cone be placed at each feature location to allow automatic feature event triggering during profile testing. It is further recommended that temporary marks be placed in one or both of the wheelpaths where roadway features are present, and at every 150-ft interval. Wheelpaths shall be marked at manholes, especially where lateral offset needs to be measured

in order to determine whether the manhole should be considered as a feature or not.

- Exempt area event marking – Place event triggers on the side of the pavement at the start of each exempt area. Event marks at each of these locations shall be included in the profile data.

### **7.2 Daily Equipment Checks**

- Equipment settings – A certified operator shall ensure that the long wavelength filter setting on the profiler is set at 300 feet and the short wavelength filter is set at no greater than 0.5 feet.
- All maintenance, repair, cleaning, and calibration should be completed as recommended by the equipment manufacturer.
- Pretest calibration and calibration checks shall be completed prior to testing. Any problems noted in these daily calibration checks shall be resolved prior to official data collection. The Pretest Calibration Report in Attachment A shall be completed, signed, and provided to the Engineer prior to leaving the test site.
- Static height measurement calibration – Certified operators shall complete inertial profiler static height measurement testing according to AASHTO PP 49, Section 6.2. The average of the absolute difference between the measured and certified height of 0.25, 0.5, and 1.0 inch blocks shall be no more than 0.01 in.
- Accelerometer calibration – Accelerometer calibration of inertial profilers shall be calibrated using the manufacturer’s automated calibration software.
- Bounce testing – Certified operators shall complete inertial profiler static and dynamic bounce testing following calibration of the accelerometers and vertical height sensors. The average static (no bounce) IRI from each wheelpath sensor for at least 300 ft shall be no more than 4 in/mi. For dynamic bounce testing, the vehicle shall be bounced from the rear or the front to produce 0.5 in of total vertical displacement of the height sensors. Average dynamic bounce test IRI for at least 300 ft of simulated data collection shall be no more than 7 in/mi for lightweight profilers and 9 in/mi for high speed profilers, unless approved by the Engineer.

### **7.3 Data Acquisition**

- Prior to data collection, the operator shall update the profile project software to include the project number, direction of travel, operator, test date, test time, beginning station, and equipment parameters.
- Project profile data shall be collected in the direction of travel using a constant speed that is within the allowable range confirmed during certification. The system shall be brought to the desired testing speed far enough in advance of the beginning mark to ensure accurate profile and IRI data. Collect profile data on a length of pavement as long as practical and between predetermined exempt areas. Label each Run of Record according to the Engineer’s approved format.
- The operator shall activate all inertial profiler testing and recording

equipment so that it is stabilized at the test speed prior to reaching the project test location. The test speed shall be maintained throughout the length of the project test area.

- The inertial profiler equipment shall trigger data collection automatically at the beginning of the project test location using a photocell and reflective device. The operator shall maintain a smooth driving pattern with the height sensors centered in the wheelpaths, particularly ensuring wheelpath positioning over pavement features. The equipment shall also automatically place an event mark at the end of the measured project test location using a photocell and reflective device. Rolling inclinometer operators shall manually insert an event marks at the end of the section.
- The profiler operator shall conduct a single run of profile testing and data acquisition. If the computed  $IRI_{AVG}$  is within 15 in/mi from an IRI threshold value (i.e.  $IRI_a$ ,  $IRI_b$ ,  $IRI_c$ ,  $IRI_d$ ,  $IRI_e$  &  $IRI_f$ ) as defined in DDOT Ride Quality Specification, and with approval of the on-site DDOT personnel, the contractor may choose to conduct additional error-free two runs. The test run that yields the median  $IRI_{AVG}$  shall be used as the run of record.

## 8. REPORTING

The operator shall submit to the Engineer Operator and Equipment Certification Records, a Pretest Calibration Report, and a Field Data Report prior to leaving the site, unless approved by the Engineer.

- Operator Certification and Equipment Certification or Verification Records – A copy of the current operator certification, and a copy of the current equipment certification, or DDOT approved verification report approving the testing equipment shall be provided to the Engineer prior to data collection. The verification testing shall have been done at least annual and within the same construction season.
- Pretest Calibration Report – All pretest calibration shall be completed and reported on the form in Attachment A. One signed original of the Pretest Calibration Report shall be submitted to the Engineer for each day of testing on one project. The operator shall provide equipment and operator certification information, and verification reports sufficient to confirm their adequacy for testing.
- Field Data Report – A field IRI printout from all runs of record shall be submitted to the Engineer. The printout shall include the left and right wheelpath IRI values for each full 25-ft segment between predetermined exempt areas or from the end of an exempt area and the end of the testing area. The field data report shall define the project stations for all exempt areas and project feature location, as defined in DDOT Ride Quality Specification. Descriptions or explanations shall be provided for each exempt area. All 25-ft segments that include features shall be marked on the Field Data Report with a description or code for the feature type.

Within 72 hours of profile QC data collection, the contractor shall submit an electronic copy in Microsoft® Excel format, and if requested by the Engineer a printed copy, of

the test results for the pavement being measured as generated by the test equipment performing the test. This report shall be for project-level QC or QA data and shall include:

- (a) Header information including the equipment identification and approval date, site description (route, lane, limits, and direction), date and time of testing, equipment filter and sampling settings, the operator's name, profile collection equipment software versions, and test speed data (if not given for each segment)
- (b) A column identifying the project station number for each measured 25-ft segment
- (c) Columns associated with (b) for the left, right, and average wheelpath 25-ft segment IRI values for each run of record
- (d) The exact stationing limits and description for all feature segments which are not included in IRIAVG computations but are subject to defect evaluation
- (e) The exact stationing limits and a description of all exempt areas which are not to be included in pay adjustment calculations

These data shall be provided in the Microsoft Excel format shown in Attachment B: Electronic Data Format.

Raw profile data (distance and elevation values) shall be saved and archived by the contractor and shall be available for all project QC data review until the project is closed.

## Attachment A: Pretest Calibration Report

<u>Date:</u>	
<u>Contractor:</u>	
<u>Job Location:</u>	
<u>Operator (print):</u>	
<u>Operator Certification Date:</u>	
<u>Operator Certification Expiration Date:</u>	
<u>Test Vehicle Certification Number:</u>	
<u>Test Vehicle Certification / Expiration Date:</u>	/
<u>Test Vehicle Verification Date:</u>	

DMI Check:

Test Site Length, ft	Measured Length, ft			
	Run 1	Run 2	Run 3	Average

Note: Average measured length must be within 0.1 percent (0.1%) of the test section length

Height Sensor Calibration Block Check:

Left	Block height, in		Right	Block height, in	
	Nominal	Actual		Measured	Nominal
0.25 inch			0.25 inch		
0.5 inch			0.5 inch		
1.0 inch			1.0 inch		

Note: Average measured block height must be within 0.01 in of the actual block height

Accelerometer Calibrated (circle one): Yes / No

Selected Long Wavelength Cutoff (ft) \_\_\_\_\_

Bounce Test:

Left Sensor		Right Sensor	
Static IRI, in/mi	Dynamic IRI, in/mi	Static IRI, in/mi	Dynamic IRI, in/mi

Note: Static IRI must be  $\leq 4$  in/mi. Bounce 0.5 in. Dynamic IRI must be  $\leq 7$  in/mi (lightweight)  $\leq 9$  in/mi (high-speed)

Operator (sign)	
Contractor (sign)	
Inspector (print)	
Inspection Agency (print)	
Inspector (sign)	

**Attachment B: Electronic Data Format**

Each page described in this Attachment shall be a separate worksheet in the delivered Microsoft EXCEL Workbook. The expected worksheet name, or an example of a worksheet name, is shown in parenthesis.

**Contract Information Page (Contract Info)**

This page contains general contract information used in the DDOT ride specification software utility.

Field Names	Information
Contract Name	ARA01
Functionl Class	Minor Arterial
Work Description	resurface
Street	17th st
From Street	Constitution Ave
To Street	C St
Year	2007
Quad	NE
Ward	1
Width, ft	36
Length, mile	0.09
No. Blocks	1
Start SISID	20170020
End SISID	20170020
Total Bid Price, \$	
Bid Price for each 25-ft segment, \$	500
<b>DC Ride Spec Lot Information</b>	
Field Names	Information
Test Lot	N_1_1
From Street	Constitution Ave
To Street	C St

**Master Page (Master)**

This worksheet contains the worksheet names for the worksheets contains the header, feature and IRI data for the lot tested.

WorkSheetNames	Description
17STS1_Header	
17STS1_IRI_File_1	QCRun1
17STS1_IRI_File_2	QCRun2
17STS1_IRI_File_3	QCRun3
17STS1_IRI_File_4	QCRun4
end	

**Header/Features Page** (example: 17STS1\_Header)

This page contains the header information for the data files collected with the inertial profiler and required for the DDOT ride specification software utility. It also contains the locations and descriptions of the feature items located within the lot tested.

Header Information

File Name	Vehicle Identification	Approval Date	Route	Lane	From Station	To Station	Dir	Test Date	Test Time
17STS1.E01	MULE	11/01/2007	17TH ST NE	1	0	437	South(+)	11/14/2007	16:40:42
end									
Wave Long	Wave Short	Contractor	Driver	Reporting Software Version	Vehicle Software Version	Speed (mph)	Sample Rate (ft)		
300 ft	none	ARA/MAD	Brian	RP090L v3.42 - 12 AUG 2003	MD0906	12	25		

(Please note that the header information needs to be on the same line in the EXCEL Worksheet)

Feature Information

SrcFile	Station Location	Event Code	Feature Description
17STS1		0 Section	Section Start
17STS1		0 EVNT	Construction Joint
17STS1		399 EVNT	Manhole
17STS1		413 EVNT	Manhole
17STS1		419 EVNT	Manhole
17STS1		437 SEC END	/
end			

**Exempt Areas Page** (Exempt Areas)

This page contains the location and description of all Exempt Areas contained within the lot tested.

Route	Station From	Station To	Exempt Area Description

**IRI Data Page** (example: 17STS1\_IRI\_File\_1)

This page contains the IRI data for each 25-ft segment within the lot tested.

File Name	Route	Test Date	RefAdj	Station from	Station To	SegLen	IRI1	IRI2	IRIAvg
17STS1.P02	17THSTNE	11/4/2007	(R)=	0	25	25	432	390	411
17STS1.P02	17THSTNE	11/4/2007		25	50	25	244	212	228
17STS1.P02	17THSTNE	11/4/2007		50	75	25	128	206	167
17STS1.P02	17THSTNE	11/4/2007		75	100	25	137	75	106
17STS1.P02	17THSTNE	11/4/2007		100	125	25	143	113	128
17STS1.P02	17THSTNE	11/4/2007		125	150	25	187	192	190
17STS1.P02	17THSTNE	11/4/2007		150	175	25	206	146	176
17STS1.P02	17THSTNE	11/4/2007		175	200	25	139	228	183
17STS1.P02	17THSTNE	11/4/2007		200	225	25	151	175	163
17STS1.P02	17THSTNE	11/4/2007		225	250	25	153	156	155
17STS1.P02	17THSTNE	11/4/2007		250	275	25	157	110	134
17STS1.P02	17THSTNE	11/4/2007		275	300	25	108	159	133
17STS1.P02	17THSTNE	11/4/2007		300	325	25	194	141	168
17STS1.P02	17THSTNE	11/4/2007		325	350	25	115	164	139
17STS1.P02	17THSTNE	11/4/2007		350	375	25	103	132	118
17STS1.P02	17THSTNE	11/4/2007		375	400	25	190	161	176
17STS1.P02	17THSTNE	11/4/2007		400	425	25	904	1160	1032
17STS1.P02	17THSTNE	11/4/2007		425	437	12	565	776	671
end									

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