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GENERAL PROVISIONS AND STANDARD
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PART I

GENERAL PROVISIONS FOR
CONSTRUCTION CONTRACTS

GP – SECTION 1

DEFINITIONS AND TERMS

GP-1.01 Abbreviations

Reference to a technical society, institution, association or governmental authority is made in the Specifications in accordance with the following abbreviations:

| | |
|--------|--|
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI | American Concrete Institute |
| AISC | American Institute of Steel Construction |
| ANSI | American National Standards Institute |
| AREA | American Railway Engineering Association |
| ASA | American Standards Association, Inc. |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWS | American Welding Society |
| AWWA | American Water Works Association |
| CRSI | Concrete Reinforcing Steel Institute |
| DIPRA | Ductile Iron Pipe Research Association |
| FM | Fractory Mutual |
| FS | Federal Specifications and Standards, General Services Administration |
| IEEE | Institute of Electrical and Electronic Engineers |
| IES | Illuminating Engineering Society |
| MOSHA | Maryland Occupational Safety and Health Act |
| MIL | Military Specifications |
| MPS | Maryland Park Service |
| MSHA | Maryland Department of Transportation State Highway Administration |

| | |
|-------|---|
| MUTCO | Manual on Uniform Traffic Control Device |
| NBS | National Bureau of Standards |
| NEC | National Electric Code |
| NEMA | National Electrical Manufacturer's Association |
| NFPA | National Fire Protection Association |
| OSHA | Occupational Safety and Health Administration |
| SSPC | Steel Structure Painting Council |
| UL | Underwriters Laboratories Incorporated |

GP-1.02 Definitions

Administration – **The City of Frederick, acting through its authorized representatives at agency, department, or executive level.**

Addendum – **Any addition, alteration, correction or deletion to original contract documents.**

Award – **The decision by a procurement agency to appoint or present a purchase agreement or contract to a vendor.**

Bid – **A statement of price, terms of sale, and description of the supplies, services, or construction offered by a vendor to the City.**

Bid Board – **A Bulletin board displayed in an area to which the public has access and on which is posted solicitations or announcements of availability of solicitations or both.**

Bid Bond – **See Proposal Guaranty**

Bid Form – **The approved form on which the City requires bids to be set forth and submitted.**

Bidder – **A person formally submitting a bid for the work contemplated, acting directly or through a duly authorized representative.**

Board – **The Mayor and Board of Aldermen of the City of Frederick.**

Business – **A corporation, partnership, individual, sole proprietorship, joint venture, or any other legal entity through which commercial activity is conducted.**

Calendar Day – Every day shown on the calendar, Saturdays, Sundays, and holidays included.

Change Notice – A written or an oral directive issued by the Administration’s representative directing a Contractor to make a change in the work.

Change Order – A written order signed by the responsible Administration’s representative, directing a contractor to make changes clause of a contract authorizes the Administration’s representative to order with or without the consent of the contractor.

City – The City of Frederick, Maryland, and/or its authorized representatives.

Construction – The process of building, adding, altering, converting, relocating, renovating, replacing, or restoring of real property in which the City has an interest.

Contingent Item – Any time listed in the contract documents and included in the bid for the purpose of obtaining contract price. Such bid constitutes tender of an exercisable option to incorporate such items into the work in accordance with stated terms at bid prices.

Contract – Any agreement entered into by a City agency for the procurement of supplies, services, construction, or any other item and includes:

- (1) Awards and notices of award;
- (2) Contracts of a fixed-price, cost-reimbursement, cost-plus-a-fixed fee, fixed-price incentive, or cost-plus incentive fee type;
- (3) Contracts providing for the issuance of job or task orders;
- (4) Leases;
- (5) Letter contracts;
- (6) Purchase Order;
- (7) Supplemental agreements with respect to any of these;
- (8) Orders, and
- (9) Grants.

Contract does not include:

- (1) Collective bargaining agreements with employee organizations; or
- (2) Medical, Medicare, Judicare, or similar reimbursement contracts for which user eligibility and cost are set by law or regulation.

Contract Documents – The written agreement executed between an Administration and the successful bidder, covering the performance of the work and furnishing of labor, equipment, and materials, by which the Contractor is bound to perform the work and furnish the labor, equipment, and materials, and by which the City is obligated to compensate him therefore at the mutually established and accepted rate or price. The Contract shall include the Invitation for Bids, Notice to Contractors, Instructions to Bidders, Proposal, Contract Forms and Bonds, General Provisions, all Technical Provisions, all Plans and

Notice to Proceed, and any written Change Orders and Supplemental Agreements that are required to complete the construction of the work in an acceptable manner, including authorized extension thereof.

Contract Drawings – See definition of “Plan”

Contract Item (Pay Item) – An item of work specifically described and for which a price, either unit or lump sum, is provided. It includes the performance of all work and the furnishing of all labor, equipment, and materials, described herein or described in any Supplemental Specifications or Special Provisions.

Contract Modification – Any written alteration in the specifications, delivery point, date of delivery, contract period, price, quantity, or other provision of any existing contract whether accomplished in accordance with a contract provision, or by mutual action of the parties to the contract. It includes change orders, extra work orders, supplemental agreements, contract amendments, reinstatements, or options/renewals.

Contractor – Any person having a contract with a City Agency. Contractor does not include employees with labor contracts (collective bargaining agreements).

Contract Time or Completion Date – The number of working or calendar days shown in the contract indicating the time allowed for the completion of the work contemplated in the contract. In case a calendar date of completion is shown in the contract, in lieu of the number of working or calendar days, such work shall be completed by that date.

Controlling Operation – An operation of either major or minor proportions, which at the particular time under consideration has a controlling effect on the progress of the project as a whole.

Day – Calendar day unless otherwise designated.

Easement – A grant of right of use of the property of an owner for a certain purpose at the will of the grantee.

Highway Standards – The official Book of Standards, Highway and Incidental Structures edited by the State Highway Administration with latest in corporate revisions issued on or before the date of advertisement of the contract unless otherwise noted.

Inspector – The authorized representative of the City of Frederick assigned to make detailed inspection of any or all portions of the work or materials therefore.

Invitation for Bids – Any document, whether attached or incorporated by reference, used for soliciting bids under procurement by competitive sealed bidding and small procurement procedures including requests for quotations.

Invitation for Quotation – Invitation for Bids.

Laboratory – Any testing laboratory which may be designated by the procurement officer.

Materials – Any substances specified for use in the construction of the project and its appurtenances.

Notice to Contractors – The advertisement for Bids for all required work or materials. Such advertisement will indicate the location and magnitude 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 bids.

Notice to Proceed – A written notice to the contractor of the date on or before which he shall begin the prosecution of the work to be done under the contract.

Owner – The City of Frederick

Payment Bond – Security as a guarantee that contractor will pay in full all bills and accounts for materials and labor use in the work, as provided by law.

Performance Bond – Security guaranteeing complete performance of the contract.

Permit – The document required by the appropriate regulating agency.

Person – Any individual, business, union, committee, club or other organization.

Plans – The official drawings issued by the City as part of the contract documents, including those incorporated in the contract documents by reference.

Proposal – The response by an offeror to a solicitation by a City Agency for construction. The response may include but is not limited to an offeror's price and terms for the proposed contract, a description of technical expertise, work experience and other information as requested in the solicitation. As used herein the word "proposal" means bids.

Proposal Form – The approved form on which a City Agency requires proposals to be set forth and submitted.

Proposal Guaranty – The security designated in the Proposal, to be furnished by the offeror as a guaranty of good faith to enter into a contract with the City if the work of constructing the improvement is awarded to him.

Questionnaire – The approved form or forms upon which the contractor shall furnish the information as to his ability to perform the work, his experience in

similar work, the equipment to be used, and his financial condition as related to his ability to finance the work.

Responsible Bidder or Offeror – A person who has the capability in all respects to perform fully the contract requirements, and the integrity and reliability which shall assure good faith performance.

Responsive Bidder – A person who has submitted a bid under procurement by competitive sealed bidding which conforms in all material respects to the requirements contained in the invitation for bids.

Specification – A written description of the functional characteristics, or the nature of a construction item to be procured. It may include a statement of any of the user's requirements and may provide for inspection, testing, or preparation of a construction item before procurement.

Standard Specifications – A book of specifications intended for general application and repetitive use.

State – The State of Maryland acting through its authorized representative.

Subcontractor – Any person undertaking the constructing of a part of the work under the terms of the contract, by virtue of an agreement with the Contractor, who, prior to such undertaking, receives the (consent of the surety and the) approval of the City.

Superintendent – The executive representative of the Contractor authorized to receive and execute instructions from the Administration's representative and who shall supervise and direct the construction.

Supplemental Agreement – Any contract modification, which is accomplished by the mutual action of the parties.

Supplemental Specifications – Additions and revisions to the Standard Specifications. Generally include new or improved procedures, construction items or materials developed subsequent to the publication of Standard Specifications.

Surety – The corporate body bound with and for the Contractor, for the full and complete performance of the contract, and for the payment of all debts pertaining to the work. When applying to the Bid Bond, it refers to the corporate body which engages to be responsible in the execution by the bidder of a satisfactory contract.

Work – Work shall be understood to mean the furnishing of all labor, materials, equipment, and other incidentals necessary to the successful completion of the project and the carrying out of all the duties and obligations imposed by the contract.

GP - SECTION 2

BIDDING REQUIREMENTS AND CONDITIONS

GP-2.01 Notice to Contractors

The Notice to Contractors, which may be published as an advertisement, contains a description of the proposed work, together with information to the bidder regarding access to bid forms, plans and specifications, the nature of bid guaranty, and the reservation of the right of the Administration to reject any or all bids.

GP-2.02 Contents of Bid Forms

The bid form describes the location and type of work contemplated by the contract and includes a listing of pay items. Where pay items are unit price items, the bid form will further show the approximate estimate of quantities expected to occur in such unit price items. Unless otherwise provided in the Invitation for Bids, bid prices are irrevocable for 90 days following bid opening.

The bid form sets forth the place, date, and time of opening bids, guaranty and the time to be allowed for completing the contract. The Administration may charge a sum for each set of documents, the amount of such charges being set forth in the Notice to Contractors. The sum charged for each set of documents is not returnable unless specifically indicated in the Notice to Contractors. All papers included in, bound thereto, or attached to the bid form are necessary parts thereof and shall not be detached, separated or altered.

The plans, specifications, referred to specifications, and all other contract documents will be considered a part of the bid form whether attached thereto or not.

GP-2.03 Interpretation of Quantities in Bid Schedule

The quantities appearing in the prepared bid schedule are approximate only and are prepared for the canvassing of bids. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the contract. It is understood that the scheduled quantities of work to be done and materials to be furnished may each be increased, diminished, or omitted without in any way invalidating prices bid, except as hereinafter provided.

GP-2.04 Site Investigation

The Contractor acknowledges that he has investigated and satisfied himself as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river stages, tides or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the work. The Contractor further acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the City, as well as from information presented by the drawings and specifications made a part of this contract. Any failure by the Contractor to acquaint himself with the available information may not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the work. The City assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the City.

GP-2.05 Taxes - Responsibility for Payment, Exemptions, Forms to be Filed, Etc.

- A. The Contractor is responsible for, and by submitting a bid agrees to pay, all retail sales, income, real estate, sales and use, transportation and special taxes applicable to and assessable against any materials, equipment, processes, and operations incident to or involved in the construction. The Contractor is responsible for ascertaining and acquainting himself with such taxes and making all necessary arrangements to pay same.**
- B. The Director of Finance may not authorize payment to a contractor who has submitted an invoice if that contractor is indebted by virtue of unpaid taxes or other obligations owed in the amount of Fifty Dollars (\$50) or more to any City Agency. In this regard, contractors shall indicate their Federal Tax Identification or Social Security number on the face of each invoice billed to Administration.**
- C. If taxes or other obligations are owed to the City, payment shall be deferred and the Contractor shall be timely notified. Subsequent release of the deferred payment shall be promptly made when the taxes or other obligations are satisfactorily resolved. The taxes or other obligations shall be resolved either by set-off of the amount due the Contractor against the amounts due the City or by direct payment.**
- D. The Administration hereby reserves the right to withhold final payment under this contract until the Contractor and any subcontractors performing any duties under this contract have paid all City taxes or other obligations due to the City of Frederick.**

GP-2.06 Preparation of Bid

- A. The bidder shall submit his bid upon the blank form(s) furnished by the Administration. The bidder shall specify a price in dollars and cents for each pay item given, and shall show the products of the respective unit prices and quantities written in figures in the column provided for that purpose, together with the total amount of the bid obtained by adding the amounts of the several items.
- B. The bid form(s) shall be filled out legibly in ink or typed. The bid, if submitted by an individual, shall be signed by such member or members of the partnership as have authority to bind the partnership; if submitted by the corporate secretary or an assistant corporate secretary. If not signed by an officer, as aforesaid, there must be attached a copy of that portion of the Bylaws or a copy of a Board resolution, duly certified by the corporate secretary, showing the authority of the person so signing on behalf of the corporation. In lieu thereof, the corporation may file such evidence with the Administration, duly certified by the corporate secretary, together with a list of names of those officers having authority to execute documents on behalf of the corporation, duly certified by the corporate secretary, which listing shall remain in full force and effect until such time as the Administration is advised in writing to the contrary. In any case, where a bid is signed by an Attorney in Fact, the same must be accompanied by a copy of the appointing document, duly certified. All bids shall be signed in ink. All erasures or alterations shall be initialed by the signer in ink.
- C. Bid Samples and Descriptive Literature
Invitation to bids shall state when the bidder is required to furnish samples or descriptive literature.
- D. Offerors should give specific attention to the identification of those portions of their proposals which they deem to be confidential, proprietary information or trade secrets and provide any justification of why such materials, upon request, should not be disclosed by the City under the Maryland Public Information Act, Article 76A, Sections 1 through 5 of the Annotated Code of Maryland.

GP-2.07 Proposal Guaranty

- A. No bid will be considered for any contract unless accompanied by a guaranty in an amount not less than five percent (5%) of the amount bid, and made payable to the City of Frederick.

GP-2.08 Delivery of Bids

Each bid must be submitted in a sealed envelope plainly marked to indicate its contents. When sent by mail, the sealed bid must be addressed to the City of Frederick at the address and in care of the official in whose office the bids are to be received. All bids shall be filed prior to the time and at the place specified in the Notice to Contractors. Bids received after the time for opening of bids will be returned to the bidder unopened.

GP-2.09 Pre-Bid Conferences

Pre-Bid conferences may be conducted by the Administration's representative to explain the procurement requirements. If they are to be conducted, notice of same will be contained in the Invitation for bids.

GP-2.10 Addendums to Invitations for Bids

A. Form

Addendums to Invitation for Bids shall be identified as such and shall require that the bidder acknowledge receipt of all addendums issued. The addendum shall reference the portion of the Invitation for Bids it amends. Any addendum shall be issued by the Administration's representative in writing.

B. Distribution

Addendum shall be sent to all prospective bidders who were sent an Invitation for Bids who have obtained the bidding document.

C. Timeliness

Addendums shall be distributed to prospective bidders to allow a reasonable time to consider them in preparing their bids. If the distribution does not permit timely preparation, the bid receipt date shall be changed in the addendum or, if necessary, by telegram or telephone, and confirmed in the addendum.

GP-2.11 Pre-Opening Modification or Withdrawal of Bids

A. Procedure

Bids may be modified or withdrawn by written notice received in the office designated in the Invitation for Bids before the time and date set for bid opening. A telegraphic modification or withdrawal received by telephone from the receiving telegraph company office before the time and date set for

bid opening shall be effective if the telegraph company confirms the telephone message was received at the telegraph company's office before the time and date set for bid opening.

B. Disposition of Bid Security

If a bid is withdrawn in accordance with this regulation, the bid security, if any, shall be returned to the bidder.

C. Records

All documents relation to the modification or withdrawal of bids shall be made a part of the appropriate procurement file.

GP-2.12 Late Bids, Late Withdrawals, and Late Modifications

A. Policy

Any bid received at the place designated in the solicitation after the time and date set for receipt of bids is late. Any request for withdrawal or request for modification received after the time and date set for opening of bids at the place designated for opening is late.

B. Treatment

A late bid, late request for modification, or late request for withdrawal may not be considered. Exceptions may be made when a late bid is received before contract award, and the bid, the modification, or withdrawal would have been timely but for the action or inaction or of City personnel directing the procurement activity or their employees.

GP-2.13 Opening and Recording of Bids

A. Opening and Recording

Bids and modifications shall be opened publicly, at the time, date, and place designated in the Invitation for Bids. The name of each bidder, the bid price, and such other information as is deemed appropriate shall be read aloud or otherwise made available. This information also shall be recorded at the time of bid opening. The bids shall be tabulated or a bid abstract made. The opened bid shall be available for public inspection at a reasonable time after bid opening but in any case before contract award, except to the extent the bidder designates trade secrets or other proprietary data to be confidential. Material so designated shall accompany the bid and shall be readily separable from the bid in order to facilitate public inspection of the non-confidential portion of the bid. Prices, makes, and model or catalog numbers

of the items offered, deliveries, and terms of payment shall be publicly available at a reasonable time after bid opening, but in any event before contract award regardless of any designation to the contrary at the time of bid opening.

B. Confidential Data

The Administration's representative shall examine the bids to determine the validity of any requests for nondisclosure of trade secrets and other proprietary data identified in writing. Confidential, proprietary information, and trade secrets furnished by a bidder or offeror may be disclosed to another City agency only if there is a demonstrated need for the information and may not be disclosed outside the City government except as provided by the Public Information Act or other applicable laws of the State of Maryland.

GP-2.14 Mistakes in Bids

A. General

Technicalities or minor irregularities in bids, as defined below, may be waived if the Administration's representative determines that it shall be in the City's best interest. The Administration's representative may either give a bidder an opportunity to cure any deficiency resulting from a technicality or minor irregularity in his bid, or waive the deficiency where it is the City's advantage to do so.

When at any public opening of bids, a bid appears to be irregular, as herein specified, this fact may be announced when read. Said bid shall be read as other bids and then referred to the Administration's representative for consideration and appropriate action thereon in accordance with these General Provisions. Pending a determination by the Administration's representative, any bid having one or more of the following faults will be considered irregular:

- (1) If the bid form furnished by the Administration is not used or is altered.**
- (2) If not prepared as directed in GP-2.06.**
- (3) If there is an omission of a necessary word(s) or numeral(s) required to make a price unmistakably clear, as well as any other omission, or addition of item(s) not called for.**
- (4) If the bid form does not include a price for each item in the unit price schedule.**
- (5) If there are additions, conditions or unauthorized alternate bids, unless prior to the data set for the opening said bids, the Administration notifies in writing all bidders to whom such bid documents have been issued, that such changes will be permitted.**

- (6) **If the bidder adds any provisions reserving the right to accept or reject the award.**

A minor irregularity is one which is merely a matter of form and not of substance or pertains to some immaterial or inconsequential defect or variation of a bid or proposal from the exact requirement of the solicitation, the correction or waiver of which would not be prejudicial to other bidders or offerors. The defect or variation in the bid or proposal is immaterial and inconsequential when its significance as to price, quantity, quality, or delivery is trivial or negligible when contrasted with the total cost or scope of the supplies or services being procured and the intent and meaning of the entire bid or proposal is clear. The Administration's representative shall either give the bidder or offeror an opportunity to cure any deficiency resulting from a minor informality or irregularity in a bid or proposal or waive the deficiency, whichever is to the advantage of the City.

B. Mistakes Discovered Before Opening

A bidder may correct mistakes discovered before the time and data set for bid opening by withdrawing or correcting the bid as provided in GP-2.11.

C. Confirmation of Bid

When the Administration's representative knows or has reason to conclude that a mistake had been made, the bidder may be requested to confirm the bid. Situations in which confirmation should be requested include obvious, apparent errors on the face of the bid or a bid unreasonably lower than the other bids submitted. If the bidder alleges mistake, they may be corrected or withdrawn if any of the following conditions are met:

- (1) **If the mistake and the intended correction are clearly evident on the face of the bid document, the bid shall be corrected to the intended correct bid and may not be withdrawn. Examples of mistakes that may be clearly evident on the face of the bid document are typographical errors, errors in extending unit prices, transposition errors, and arithmetical errors.**
- (2) **A bidder may be permitted to withdraw a low bid if:**
 - (a) **A mistake is clearly evident on the face of the bid document but the intended correct bid is not similarly evident; or**
 - (b) **The bidder submits proof of evidentiary value which clearly and convincingly demonstrates that a mistake was made.**

D. Mistakes Discovered After Award

Mistakes may not be corrected after award of the contract except when the Administration's representative makes a determination that it would be unconscionable not to allow the mistake to be corrected. Changes in the

price are not permitted. Corrections shall be submitted to and approved by the Administration's representative.

E. Determinations Required

When a bid is corrected or withdrawn, or correction or withdrawal is denied, the Administration's representative shall prepare a determination showing the relief was granted or denied in accordance with these General Provisions.

GP-2.15 Rejection of Individual Bids or Proposals

A. Any bid may be rejected in whole or in part when it is in the best interest of the City to do so.

B. Reasons for rejection of a bid include but are not limited to:

- (1) **The vendor that submitted the bid is non-responsible as determined under these General Provisions;**
- (2) **The bid is not responsive; that is, it does not conform in all material respects to the solicitation;**
- (3) **Unreasonable price;**
- (4) **Bidder debarred or ineligible and period of debarment or ineligibility not expires;**
- (5) **The unit prices contained in a bid are obviously unbalanced;**
- (6) **Evidence of collusion among bidders;**
- (7) **Obvious lack of experience, adequate plant or other equipment is revealed by supplemental information which may be required to be submitted by the Contractor and provided for elsewhere in the contract document;**
- (8) **Contractor's workload which, in the judgment of the Administration, might hinder or prevent the prompt completion of the subject work if awarded;**
- (9) **Default by the bidder on other contracts awarded in Maryland or by other governmental agencies;**
- (10) **Failure to pay or satisfactorily settle all reasonable and just bills due for labor and material on former contracts in force at time of letting;**

- (11) **If the same person has an interest in more than one bid on a contract, exclusive of being named by another bidder as a subcontractor;**
- (12) **If the bid is found to be irregular for any of the reasons listed in GP-2.14.**

GP-2.16 Bid Evaluation and Award

A. General

The contract is to be awarded to the responsible and responsive bidder whose bid meets the requirements and evaluation criteria set forth in the Invitation for Bids, and is either the lowest bid price or lowest evaluated bid price. A bid may be evaluated for any requirement or criterion that is not disclosed in the Invitation for Bids.

B. Determination of Lowest Bidder

Bids shall be evaluated to determine which bidder offers the lowest cost to the City in accordance with the evaluation criteria set forth in the Invitation for Bids. Only objectively measurable criteria which are set forth in the Invitation for Bids shall be applied in determining the lowest bidder. The Administration reserves the right to make the award by item, or groups of items, or total bid if is in the best interest of the City to do so, unless the bidder specifies in his bid that a partial or progressive award is not acceptable.

C. Restrictions

Nothing in this provision shall be deemed to permit contract award to a bidder submitting a higher quality item than that designated in the Invitation for Bids if that bidder is not also the lowest bidder. Further, this provision does not permit negotiations with any bidder.

D. Award

Upon determination of the lowest bidder, review of the bid for responsiveness, and satisfaction that the bidder is responsible, the contract may be awarded to that bidder.

GP-2.17 Tie Bids

A. Definition

Tie bids are responsive bids from responsible bidders that are identical in price, terms and conditions and which meet all the requirements and evaluation criteria set forth in the Invitation for Bids.

B. Award

In the instance of low tie bids, the award shall be made to the in-City business if identical bids are received from an in-City and out-of-City bidder. If identical low bids are received from in-City bidders or from out-of-City bidders, a drawing shall be conducted. A witness shall be present to verify the drawing and the result shall be certified of the bid tabulation sheet.

C. Record

Records shall be made of all Invitation for Bids on which tie bids are received and a copy shall be forwarded to the City Attorney.

GP-2.18 Documentation of Award

Following an award, a record showing the basis for determining the successful bidder shall be made a part of the procurement file.

GP-2.19 Publicizing Awards

Written notice of award shall be sent to the successful bidder.

GP-2.20 Disposition of Bids

When bids are rejected, or a solicitation cancelled after bids are received, the bids which have been opened shall be retained in the procurement file, or if unopened, returned to the bidders upon request and the file so documented.

GP-2.21 Time for Bid Acceptance

- A. **Unless otherwise provided in the Invitation for Bids, bid prices are irrevocable for a period of 90 days following bid opening.**
- B. **After opening bids, the Administration's representative may request bidders to extend the time during which the city may accept their bids, provided that, with regard to bids, no other change is permitted.**

GP-2.22 Only One Bid

If only one responsive bid is received in response to an Invitation for Bids, an Award may be made to the bidder if the Administration's representative

determines that the Price submitted is fair and reasonable, and that other prospective bidders had reasonable opportunity to respond, or there is not adequate time for resolicitation. Otherwise, the bid may be rejected pursuant to the provisions of these General Provisions and;

- A. New bids may be solicited;
- B. The proposed procurement may be cancelled; or
- C. If the agency head determines in writing that the need for the supply or service continues, but that the price of the one bid is not fair and reasonable and there is not time for resolicitation or resolicitation would likely be futile, the procurement may then be conducted in a manner considered by the Administration to be in the best interest of the City.

GP-2.23 Multiple or Alternate Bids

Unless multiple or alternate bids are requested in the solicitation, these bids may not be accepted. However, if a bidder clearly indicates a base bid, it shall be considered for award as though it were the only bid submitted by the bidder. The provisions of this regulation shall be set forth in the solicitation and, if multiple or alternate bids are allowed it shall specify their treatment.

GP-2.24 Conditioning Bids Upon Other Awards Not Acceptable

Any bid which is conditioned upon receiving award of both the particular contract being solicited, and another City contract shall be deemed nonresponsive and not acceptable.

GP-2.25 Responsible and Responsive

Before award, the Administration's office shall determine that a bidder or offeror is responsible and responsive. The unreasonable failure of a bidder or offeror to supply information promptly in connection with a determination shall be grounds for determination that the bidder or offeror is not responsive and responsible.

GP-2.26 Rejection of All Bids

- A. After opening of bids or proposal but before award, all bids or proposals may be rejected in whole or in part when the Administration's representative with the approval of the agency head or his designee,

determines that this action is fiscally advantageous or otherwise in the City's best interest. Reasons for rejection of all bids or proposals include but are not limited to:

- (1) The City agency no longer requires the procurement;**
- (2) The City agency no longer can reasonably expect to fund the procurement;**
- (3) Proposed amendments to the solicitation would be of such magnitude that a new solicitation is desirable;**
- (4) Prices exceed available funds and it would be appropriate to adjust quantities to come within available funds;**
- (5) There is reason to believe that the bids may nor have been independently arrived at in open competition, may have been collusive, or may have been submitted in bad faith;**
- (6) Bids received indicate that the needs of the City agency can be satisfied by a less expensive equivalent item differing from that on which the bids or proposals were invited; or**
- (7) All otherwise acceptable bids received are at unreasonable prices.**

B. A notice of rejection of all bids shall be sent to all vendors that submitted bids. The notice shall:

- (1) Identify the solicitation;**
- (2) Briefly explain the reason for cancellation; and**
- (3) If appropriate, explain that an opportunity shall be given to compete on any resolicitation or any future procurements of similar construction.**

C. Documentation

The determination of the reasons for cancellation or rejection of all bids or proposals shall be made a part of the procurement file.

GP-2.27 Cancellation of Invitations for Bids

A. Before opening of bids, a solicitation may be cancelled in whole or in part when the Administration's representative, with the approval of the agency head or his designee, determines that this action is fiscally advantageous to the City or otherwise in its best interest. Reasons for cancellation include but are not limited to:

- (1) **The absence of a containing need for the construction;**
 - (2) **Proposed amendments to the solicitation which would be of such magnitude and substance that a new solicitation is desirable.**
- B. **When a solicitation is cancelled before bid opening, the bids shall be returned to the vendors submitting them and a notice of cancellation shall be included. The notice of cancellation shall:**
- (1) **Identify the solicitation;**
 - (2) **Briefly explain the reason for cancellation; and**
 - (3) **If appropriate, explain that an opportunity shall be given to compete on resolicitation or any future procurements of similar construction.**

GP – SECTION 3

AWARD AND EXECUTION OF CONTRACT

GP-3.01 Consideration of Proposals

After proposals have been publicly opened and read, they will be audited for mathematical accuracy and reviewed to determine that there are no irregularities as outlined in GP-2.14 and GP-2.26. Upon completion of the aforementioned audit and review, the results will be made available to the public. In the event of a discrepancy between the unit bid prices and the extensions (product of unit price and quantity), the unit price will govern. In the event of a discrepancy between the bid total shown on the bid form and the total determined by mathematical audit of the amounts, lump sum and extensions, that are bid for each item in the price schedule, the amount determined by mathematical audit shall govern. In the case of discrepancy between prices written in words and those written in figures, the written words shall govern. In the event that the unit price is not included, the unit price shall be the extended price divided by the quantity.

GP-3.02 Award of Contract (See GP-Section 2)

The award of the contract, if it be awarded, will be within the time specified in the bid and will be to the lowest responsive, responsible bidder whose bid complies with all the requirements prescribed. The successful bidder will be notified (by letter mailed to the address shown on his proposal) this his bid has been accepted and that he has been awarded the contract.

In all contracts jointly bid, all contractors will be held jointly and severally responsible for the performance of the entire contract.

GP-3.03 Cancellation of Award

The right is reserved to cancel the award of any contract at any time before the execution of the said contract by all parties without any liability against the City of Frederick.

GP-3.04 Return of Proposal Guaranty

All proposal guaranties, except those of the three lowest bidders, will be returned immediately following opening and the review of the proposals. The guaranty of the second and third bidder will be returned within 30 days following the award of contract. The Contractor has the right to substitute a bid bond or other bid security at any time prior to return of the proposal guaranty.

GP-3.05 Performance Bond and Payment Bond Requirements

A. Acceptable Security

for performance and payment bonds shall be

B. Performance Bonds

A performance is required for all construction contracts in the amount equal to at least 100 percent of the contract price. The performance bond shall be delivered by the bidder to the Administration no later than the time the contract is executed. If the bidder fails to deliver the required performance bond, his bid shall be rejected, his bid security shall be enforced, and award of the contract may be made to the next lowest responsive and responsible bidder.

C. Payment Bonds

A payment bond is required for all construction contracts in the amount equal to at least 100 percent of the contract price. The payment bond shall be delivered by the bidder to the Administration no later than the time the contract is executed. If a bidder fails to deliver the required payment bond, his bid shall be rejected, his bid security shall be enforced, and award of the contract shall be made to the next lowest responsive and responsible bidder.

GP-3.06 Execution of Contract

After a Notice of Award, as provided in GP-3.02, has been issued to a bidder, a contract between the Administration and the bidder receiving the award shall be deemed to be in existence. The administration shall then forward the formal contract form and the appropriate forms for the payment and performance bonds (if any) to the bidder for execution. The bidder will then execute the contract form and return same, together with fully executed payment and performance bonds (if any), to the Administration within ten (10) working days after receipt of same. After receipt of properly executed contract form and payment of performance bonds (if any), the Administration will execute the contract within 60 days and forward the bidder a copy; provided, however, that the Board has approved the contract if such approval is required. In the event the Administration fails to execute the contract within the 60-day period, the bidder will have, as its sole remedy, the option to declare the contract terminated or accept a further extended period for execution by the Administration.

GP-3.07 Failure to Execute Contract

Failure to execute the contract and file acceptable security as defined in GP-3.05 within the time aforesaid shall be just cause for the annulment of the award and the forfeiture of the proposal guaranty which shall become the property of the City of Frederick, not as a penalty but in liquidation of damages sustained. Award may then be made to the next lowest responsive, responsible bidder or the work may be readvertised and constructed under contract or otherwise, as the Administration may decide.

GP – SECTION 4

SCOPE OF WORK

GP-4.01 Intent of Contract

The Contractor shall (within specified tolerances) perform all work in accordance with the lines, grade, typical cross sections, dimensions, and other data shown on the plans or as modified by written orders, including the furnishing of all materials, implements, machinery, equipment, tools, supplies, transportation, labor, and all other things necessary to the satisfactory prosecution and completion of the project in full compliance with the contract requirements.

GP-4.02 General Provisions Controlling

In the event of a conflict between these General Provisions and any other provision of the contract documents, the General Provisions shall prevail unless such other provision expressly provides to the contrary.

GP-4.03 Variations in Estimated Quantities

Where the quantity of a pay item in this contract is an estimated quantity and where the actual quantity of such pay item varies more than 25 percent above or below the estimated quantity stated in this contract, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above 125 percent or below 75 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Administration's representative shall upon receipt of a written request for an extension of time within 10 days from the beginning of the delay, or within a further period of time which may be granted by the Administration's representative before the date of final settlement of the contract, ascertain in the facts and make the adjustment for extending the completion data as in his judgment the findings justify.

GP-4.04 Differing Site Conditions

A. The contractor shall promptly, and before such conditions are disturbed, notify the Administration's representative in writing of:

- (1) Subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or

- (2) **Unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this contract.**

The Administration's representative shall promptly investigate the conditions, and if he finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.

- B. **No claim of the Contractor under this clause shall be allowed unless the Contractor has given the notice required in A. above; provided, however, the time prescribed therefore may be extended by the City.**
- C. **No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.**

GP-4.05 Changes

- A. **The Administration's representative may, at any time, without notice to the sureties, if any, 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 specifications (including drawings and designs);**
 - (2) **In the method or manner of performance of the work;**
 - (3) **In the City-furnished facilities, equipment, materials, services, or site; or**
 - (4) **Directing acceleration in the performance of the work.**
- B. **Any other written order or an oral order (which terms as used in this paragraph (B.) shall include direction, instruction, interpretation, or determination) from the Administration's representative which causes any such change, shall be treated as a change order under this clause, provided that the Contractor gives the Administration representative written notice stating the date, circumstances, and source of the order and that the Contractor regards the order as a change order.**

- C. Except as herein provided, no order, statement, or conduct of the Administration's representative **shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment hereunder.**
- D. If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by an 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 costs incurred more than 20 days before the Contractor gives written notice as therein required; and provided further, that in no case of defective specifications for which the City is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with such defective specifications.**
- E. If the Contractor intends to assert a claim for an equitable adjustment under this clause, **he shall, within 30 days after receipt of a written change order under (A.) above or the furnishing of written notice under (B.) above, submit to the Administration's representative a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by the City. The statement of claim hereunder may be included in the notice under (B.) above.**
- F. No claim by the Contractor for an equitable adjustment hereunder **shall be allowed if asserted after final payment under this contract.**

GP-4.06 Negotiated Payment Provision

If the Contractor claims an equitable adjustment, the Contractor shall be allowed to add the following maximum percentages for overhead and profit to his costs for labor, materials, and equipment.

- A. Twenty percent **may be added by the Contractor for overhead and profit for work performed by his own forces.**
- B. Fifteen percent **may be added by the subcontractor for overhead and profit for work performed by the subcontractor; the Contractor may add an additional 5 percent of the subcontractor's costs for labor, material, and equipment.**

- C. The provision of paragraphs (A) and (B) above apply only to price adjustments negotiated prior to completion of the added or changed work and do not apply to work performed on a force account basis as provided for in paragraph GP-9.02.

GP-4.07 Unauthorized Work

Any work which may be done by the Contractor prior to receipt of the notice to proceed, work done contrary to or regardless of the instructions of the Administration's representative, work done beyond the lines and grades shown on the contract drawings, or as given, or any extra work done without written authority will be considered unauthorized and at the expense of the contractor and will not be measured and paid for. Work so done may be ordered removed and/or replaced at the Contractor's expense.

GP-4.08 Final Cleanup

Upon completion of the work specified in the contract and before final payment will be made, the construction area and all other adjoining areas, other than those owned by him, occupied by the Contractor during the construction of said contract shall be cleaned of all surplus and discarded materials, spilled materials, excess materials left deposited on the permanent work as a result of the Contractor's operations, false work, and rubbish and temporary structures and buildings, that were placed thereon by the Contractor. The adjoining areas mentioned above, outside the normal pay limits for seeding, will be reshaped, seeded and mulched, or otherwise restored as directed by the Administration's representative at the Contractor's expense.

GP – SECTION 5

CONTROL OF THE WORK

GP-5.01 Authority of the Administration's Representative

- A. The Administration's representative **shall decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of said work, all questions which may arise as to the interpretation of any or all plans and specifications, and all questions as to the acceptable fulfillment of the contract on the part of the Contractor.**
- B. The Administration's representative **shall determine the amount and quantity of work performed and materials which are to be paid for under the contract.**
- C. The Administration's representative **shall have the authority to suspend the work wholly or in part due to the failure of the Contractor to carry out provisions of the contract.**

GP-5.02 Conformity with Contract Requirements

All work performed and all materials furnished shall be in conformity with the contract requirements.

In the event the Administration's representative finds the materials or the finished product in which the materials are used or the work performed are not in reasonably close conformity with the contract requirements 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.

In the event the Administration's representative finds the material or the finished product in which the materials are used are not in conformity with the contract requirements but that acceptable work has been produced, he shall then make a determination if the work shall be accepted. In this event, the Administration's representative will provide for an appropriate adjustment in the contract price. Any action taken pursuant to this paragraph may not result in an increase of the contract price.

GP-5.03 Discrepancies in the Contract Documents

In the event the Contractor discovers any discrepancies in the contract documents, he shall immediately notify the Administration's representative. The Administration's representative will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the contract.

GP-5.04 Cooperation by Contractor

The Contractor will keep available on the project site at all times one complete set of contract documents. The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Administration's representative and his inspectors in every way possible.

The Contractor shall assign to the contract as his agent, a competent superintendent capable of communicating in English and capable of reading and thoroughly understanding the contract documents and thoroughly experienced in the type of work being performed, who shall receive instructions from the Administration's representative or his authorized representatives. The superintendent shall have full authority to execute the orders or directions of the Administration's representative without delay, and to promptly supply such materials, equipment, tools, labor and incidentals as may be required. Such superintendence shall be furnished irrespective of the amount of work sublet. Said superintendent shall be on the project site at all times when the work is in progress.

GP-5.05 Cooperation with Utilities

It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances in their present or relocated positions and that no additional compensation will be allowed for normal delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenances or the operation of moving them.

The Contractor shall have responsibility for notifying all affected utility companies prior to the necessity of performing any work on their utilities and shall cooperate with them in achieving the desired results. All damage to utility facilities caused by the Contractor's operations shall be the responsibility of the Contractor.

GP-5.06 Cooperation Between Contractors

Separate contractors on adjoining or overlapping work shall cooperate with each other as necessary. Such cooperation shall include:

- (1) Arrangement and conduct of work,

- (2) **Storage and disposal of materials, etc., by each in such manner as to not unnecessarily interfere with or hinder the progress of the work being preformed by other contractors.**

Contiguous work shall be joined in an acceptable manner.

The Administration and Department shall have the right, at any time, to contract for and perform other work in, near, over or under the work covered by this contract. In addition, other work may be preformed under the jurisdiction of another administration or City agency. In such cases, when a dispute arises among contractors, the Administration's representatives will decide which of the Administration's representative will have jurisdiction over said dispute. The Contractor shall cooperate fully with such other contractors and carefully fit his own work to such other work as may be directed by the Administration's representative.

The Contractor agrees that in event of dispute as to cooperation, the Administration's representative will act as a referee. The Contractor agrees to make no claims against the Administration for any inconvenience, delay or loss experienced by them because of the presence and operations of other contractors.

GP-5.07 Authority and Duties of Inspectors

Inspectors shall be authorized to inspect all work done and all material furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector is not authorized to revoke, alter or waive any requirements of the contract, nor is he authorized to approve or accept any portion of the complete project. He is authorized to call the attention of the Contractor to any failure of the work or materials to conform to the contract. He shall have the authority to reject materials or suspend the work until any questions at issue can be referred to and decided by the Administration's representative. Inspectors shall perform their duties at such times and in such manner as will not unnecessarily impede progress on the contract.

The inspector shall in no case act as foreman or perform other duties for the Contractor, nor interfere with the management of the work by the latter. Any advice which the inspector may give the Contractor shall not be construed as binding the Administration's representative in any way, or releasing the Contractor from fulfilling all of the terms of the contract.

Where there is disagreement between the Contractor (or his representative) and the inspector, such as refusal by the Contractor to use properly approved material, for performing work not in compliance with plans and specifications, and/or refusing to suspend work until problems at issue can be referred to and decided by the Administration's representative, the inspector will immediately direct the Administration's representative's attention to the issues of disagreement. If the Contractor still refuses to make corrections comply or suspend work, the Administration's representative will prepare and deliver in

writing to the Contractor, by mail or otherwise, a written order suspending the work and explaining the reason for such shutdown. As soon as the inspector is advised of the delivery of the shutdown order, the inspector shall immediately leave the site of the work and any work performed during the inspector's absence will not be accepted or paid for and may be required to be removed and disposed of at the Contractor's expense. Contractor will be responsible for correcting any defects in materials or workmanship whether or not inspector was present.

GP-5.08 Inspection of Work

All materials and each part or detail of the work shall be subject at all times to inspection by the Administration's representative or his authorized representative, and the Contractor will be held strictly to the materials, workmanship, and the diligent execution of the contract. Such inspection may include mill, plant, or shop inspection, and any material furnished under the contract is subject to such inspection. The Administration's representative, or his representative, shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection. Utility lines, mains, connections, house connections, etc., shall not be backfilled until inspection of same has been completed. Should Contractor fail to comply with this requirement, the inspector can and may direct that all or a portion of the work be uncovered.

If the Administration's representative requests it, Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standards required by the contract. Should the work thus exposed or examined prove acceptable, adjustments in contract time and price will be made pursuant to Section GP-4.05 for the uncovering or removing, and the replacing or the covering or making good of the parts removed.

Should the work so exposed or examined prove unacceptable, the uncovering, or removing and replacing, shall be at the Contractor's expense.

The Contractor shall be responsible for correcting any defects in material or workmanship whether or not the inspector was absent or present.

When the United States Government or any railroad, corporation, or other agency is to pay a portion of the cost of the work covered by this contract, their respective representatives shall have the right to inspect the work.

GP-5.09 Removal of Defective Work

All work and materials which do not conform to the requirement of the contract will be considered unacceptable, unless otherwise determined acceptable under the provisions in GP-5.02.

Any defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause, found to exist

shall be remedied otherwise in an acceptable manner authorized by the Administration's representative.

Upon failure on the part of the Contractor to comply promptly with any order of the Administration's representative made under the provisions of these General Provisions, the Administration's representative shall have authority to cause defective work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs from any monies due or to become due to the Contractor under this contract.

GP-5.10 Load Restrictions

The contractor shall comply with all State and local requirements pertaining to speed, size, and weight of motor vehicles.

The City may indicate in the contract load restrictions on any road or structure within the vicinity of the project.

The contractor shall take into account any and all posted bridges, the crossing of which might be contemplated by the work on the contract. No loads in excess of posted limits will be allowed in the prosecution of the work on any contract, unless the required permits are obtained from the appropriate State and local governmental agencies.

The contractor shall consider possible detrimental effects of operating heavy paving and grading equipment contiguous to retaining walls, pipe culverts, arches, forms for concrete work as well as construction existing prior to this contract.

The Administration's representative shall have the right to limit passage of heavy equipment (plus loads) when such passage or usage is causing apparent or visible damage to embankments, paving, structures or any other property.

GP-5.11 Maintenance of Work During Construction

The contractor shall maintain the work during construction and until acceptance. This maintenance shall constitute continuous and effective work prosecuted as required with adequate equipment and forces to the end that all parts of the work be kept in satisfactory condition at all times.

Particular attention shall be given to drainage, both permanent and temporary. The contractor shall use all reasonable precautionary measures to avoid damage or loss that might result from accumulations and concentrations of drainage water, and material carried by such water and such drainage shall be diverted or removed when necessary to prevent damage to excavation, embankments, surfacing, structures or property. Suitable measure shall be taken by the contractor to prevent the erosion of soil in all construction areas where the existing ground cover has been removed.

All costs of maintenance work during construction and before final acceptance shall be included in the price bid and the contractor will not be paid additional amount for such work, except as otherwise provided.

In the event that contractor's work is ordered shut down for failure to comply with the provisions of the contract, the contractor shall maintain the entire project as provided herein, and provide such ingress and egress for local residents or tenants adjacent to the project site, for tenant of the project site, and for the general public as may be necessary during the period of suspended work or until the contract has been declared in default.

On projects where traffic flow is maintained, the contractor shall be responsible for repair of all traffic damages to the work, either partially or totally completed, until such time as the work is accepted shall mean the responsibility for restoration and the cost thereof unless otherwise expressly provided for in the Special Provisions.

Steel Plates

Whenever steel plates must be used to cover an area in a roadway in the City of Frederick, the following provisions will apply:

- a. **The site inspector shall be notified in advance of any steel plates being placed in the roadway. Steel plates will not be left in the roadway longer than seven (7) calendar days, without the permission of the inspector.**
- b. **All steel plates must be flat and must be at least one inch (1") thick and held to the roadway with pins.**
- c. **Steel plates must be large enough to allow a minimum of one foot (1') of bearing on three (3) sides of the trench.**
- d. **Bituminous concrete cold mix must be used on all edges of the steel plate to minimize the hazard to the traveling public. Cold mix must be tapered from the height of the plate to the existing road surface for a minimum distance of one foot (1').**
- e. **From October 1 to April 1 all steel plates are to be marked with a stake or drum placed in the grass for identification during snow events, device shall be INTERNATIONAL ORANGE.**
- f. **The contractor shall call the Communications Office to advise where they have steel plates in the roadway, and give an emergency phone number (301)-694-1440.**
- g. **Should an emergency condition occur that the City of Frederick forces must correct, the contractor will be billed for all time, equipment and materials needed to make repairs.**
- h. **When steel plates are used, signs shall be placed approximately 500 feet in advance of the steel plates. The inspector may change the location if field**

conditions require same. Signs will conform to MUTCD Specifications and are described as follows:

Size: 8 inch by 48 inch

Color: Reflectorized Orange

Letters: Black, 8 inches high

Sign Layout: Black 1" wide stripe 1" from edge

Message: "Steel Plates Ahead", three lines centered on sign face

GP-5.12 Failure to Maintain Entire Project

Failure on the part of the contractor, at any time, to comply with the provisions of GP-5.11 above, will result in the Administration's representative immediately notifying the contractor to comply with the required maintenance provisions. In the even that the contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Administration's representative will immediately proceed with adequate forces and equipment to maintain the project and the entire cost of this maintenance will be deducted from monies due to the contractor.

GP-5.13 Acceptance

A. Partial Acceptance

If at any time during the performance of the work, the contractor substantially completes a unit or portion of the work, he may request the Administration's representative to make final inspection of that unit. If the Administration's representative finds upon inspection that the unit has been satisfactorily completed in compliance with the contract, he may accept that unit as being completed and the contractor may be relieved of further responsibility for that unit. Generally, partial acceptance will only be considered when the Administration feels that such action is in the public interest. Such partial acceptance shall in no way void or alter any of the terms of the contract.

B. Final Acceptance

Upon due notice from the contractor of presumptive completion of the entire project, the Administration's representative shall make a construction inspection and if, at such inspection, all construction provided for and contemplated by the contract is found completed, such inspection shall constitute the final inspection and the Administration's representative shall make the final acceptance as of that date, and the contractor shall be notified of such acceptance in writing. After final acceptance, the Administration will assume responsibility for maintenance except where otherwise provided by the contract.

- C. If, however, at any construction inspection, any work in whole or in part is found unsatisfactory, the Administration's representative shall give the contractor the necessary instruction as to the work required for final completion and acceptance. The contractor forthwith shall comply with and execute such instructions. Upon completion of such work, another inspection shall be made which shall constitute the final inspection if the said work is found to have been completed satisfactorily. In such event, the Administration's representative shall make the final acceptance and the contractor shall be notified as aforesaid. After final acceptance, the Administration will assume responsibility for maintenance except where otherwise provided by the contract.
- D. The contractor shall provide a one-year guarantee covering all materials and workmanship unless otherwise stipulated in the contract.

GP-5.14 Claims

Except as may otherwise be provided in other City regulations, all disputes arising under or as a result of a breach of the contract which are not disposed of by mutual agreement shall be resolved in accordance with this clause.

As used herein, "claim" means a written demand or assertion by one of the parties seeking, as a legal right, the payment of money, adjustment or interpretation of contract terms, or other relief, arising under or relating to this contract.

- (1) A voucher, invoice or request for payment that is not in dispute when submitted is not a claim under this clause. However, where the submission is subsequently not acted upon in a reasonable time, or disputed either as to liability or amount, it may be converted to a claim for the purpose of this clause.
- (2) A claim by a contractor shall be made in writing and submitted to the Administration's representative for decision. A claim by the City shall be the subject of a decision by the Administration's representative.

When a controversy cannot be resolved by mutual agreement, the contractor shall submit a written request for final decision to the Administration's representative. The written request shall set forth all the facts surrounding the controversy.

The contractor shall notify the inspector or field representative immediately of his intention to file a claim due to existing field conditions, delays, etc. In this way, the inspector can keep accurate records of time and materials expended so as to confirm or deny the Contractor's claim.

In connection with any claim under this clause, the contractor, at the discretion of the Administration's representative, can be afforded an opportunity to be heard and to offer evidence in support of his claim.

The Administration's representative shall render a written decision on all claims within ninety days (90), of receipt of the contractor's written claim, unless the Administration's representative determines that a longer period is necessary to resolve the claim. This decision shall be furnished to the contractor, by certified mail, return receipt requested or by any other method that provides evidence of receipt. If the Administration's representative's decision is not issued with ninety (90) days, the Administration's representative shall notify the contractor of the time with which a decision shall be rendered and the reasons for such time extension.

The Administration's representative decision shall be final and conclusive unless the contractor mails or otherwise files a written appeal with the Maryland State Board of Contract Appeals within thirty days of receipt of the decision.

Pending resolution of a claim, the contractor shall proceed diligently with the performance of the contract in accordance with the Administration's representative's decision.

GP – SECTION 6

CONTROL OF MATERIAL

GP-6.01 General

All materials shall meet all quality requirements of the contract. In order to expedite the inspection and testing of the materials, the Contractor shall notify the Administration's representative in writing of the sources from which he proposes to obtain all materials requiring approval, testing, inspection, or certification prior to incorporation into the work as soon as possible after receipt of notification of award of the contract.

GP-6.02 Storage and Handling of Materials

Materials shall be so stored as to assure the preservation of their quality and acceptability for the work by properly securing the area where materials are stored. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the right-of-way or project site may be used for storage purposes and for the placing of the Contractor's plant and equipment; such storage areas must be restored to their original condition by the Contractor at his expense. Any additional space required must be provided by the Contractor at his expense.

The Contractor shall exercise care in unloading and storing certain materials such as water pipe, sewer pipe, etc. to insure cleanliness. No compensation will be granted for the cost of cleaning or sterilizing such materials due to the Contractor's negligence.

Materials shall be handled in such a manner as to preserve their quality and acceptability for the work.

GP-6.03 Unacceptable Materials

Materials represented by samples taken and tested in accordance with the specified tests and failing to meet required values shall be considered to be defective regardless of prior tests or approvals.

Unless otherwise allowed by the Administration's representative as set forth below, defective materials will be removed from the site with any tags, stamps, or other markings implying conformance with specifications removed or obliterated.

Where defects can be corrected, the Contractor may propose such corrective action as he deems appropriate to the Administration's representative. The

Administration's representative may approve the corrective action but in so doing does not assume responsibility for the success thereof.

Retests will be made to determine the acceptability of the material after corrective measures have been taken. No person other than the Administration's representative may change any provision of the specifications or the contract without written authorization.

The cost of replacing, correcting, and/or removal of defective material will be the responsibility of the Contractor.

The cost of repairing or replacing other materials damaged by the installation, correction, and/ or removal of defective materials will be the responsibility of the Contractor.

GP-6.04 Administration Furnished Material

The Contractor shall furnish all materials required to complete the work, except those specified to be furnished by the City. Materials furnished by the City will be delivered or made available to the Contractor at the point or points specified in the Special Provisions. The cost of handling and placing all materials, after they are delivered to the Contractor, shall be considered as included in the contract price for the item in connection with which they are used.

The Contractor will be held responsible for all material delivered to him, and deductions will be made from any monies due him to make good any shortages and deficiencies, from any cause whatsoever, and for any damage which may occur after such deliver, and for demurrage charges.

In cases where materials are supplied by the City and incorporated in the contract work by the Contractor, materials inspection and acceptance will not be a prerequisite for acceptance of the final product as the product pertains to these items.

The Contractor will not be compensated for materials, pipe fittings, etc. that prove to be defective or are not compatible with materials found in existing systems.

GP – SECTION 7

LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

GP-7.01 Laws to be Observed

The Contractor shall keep fully informed of all federal, state, and local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the City and its representatives against any such claim or liability arising from or based on the violation of any law, ordinance, regulation, order, or decree, whether by himself or his employees or subcontractors.

The provisions of Article 21 of the Annotated Code of Maryland that are applicable to construction contracts are incorporated herein by reference.

All requirements set forth in federal assistance instruments applicable to construction contracts let by the City under a federal assistance program shall be satisfied. Therefore, to the extent that the requirements which are specified in the assistance instrument conflict with regulations adopted by the City and/or its agencies or authorities, the former shall control.

GP-7.02 Permits and Licenses

The Contractor shall procure at his own expense such permits and licenses as may be necessary in order to comply with federal, state and local laws, ordinances and regulations in performance of the work. He shall further give all notices necessary and incidental to the due and lawful prosecution of the work.

GP-7.03 Patented Devices, Materials and Processes

If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner and copy of such agreement shall be filed with the City; if no agreement is made or files as noted, the Contractor and the surety shall indemnify and save harmless the City, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, materials, or process, or any trademark or copyright, and shall indemnify, protect and save harmless the City, its officers, agents and employees with respect to any claim, action, cost or judgment for patent, trademark or copyright

infringement, arising out of purchase or use of materials, construction, supplies, equipment or services covered by this contract.

GP-7.04 Federal Participation

When the United States Government pays all or any portion of the cost of a project, the work shall be subject to the inspection of appropriate federal agency. Such inspection shall in no sense make the federal government a party to this contract, and will not interfere, in any way, with the rights of either party hereunder.

GP-7.05 Construction Safety and Health Standards

It is a condition of this contract, and shall be made a condition of each subcontract entered into pursuant to this contract, that the Contractor and any subcontractor shall not require any laborer or mechanic employed in performance of the contract to work in surrounding or under working conditions which are unsanitary, hazardous, or dangerous to health or safety, as determined under construction safety and health standards and regulations (Title 29, Code of Federal Regulations, Part 1926, formerly Part 1518, as revised from time to time) promulgated by the United States Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standard Act (83 Stat. 96), and under any construction safety and health standards and regulations promulgated by the Commissioner of Labor and Industry in accordance with the Maryland Occupational Safety and Health Act, Article 89, Sections 28 thru 49A inclusive, Annotated Code of Maryland (as the same may be amended from time to time.)

GP-7.06 Public Convenience and Safety

The Contractor at all times shall conduct the work in such manner as to ensure the least practicable obstruction to all forms of traffic. The convenience of the general public, tenants, and of the residents along and/or adjacent to the improvement shall be provided for. Material stored upon the project shall be placed so as to cause a minimum of obstruction to the public. Sprinkling shall be performed at the direction of the Administration's representative. The Contractor shall, unless otherwise specified, provide and maintain in passable condition such temporary access roads, and bridges as may be necessary to accommodate traffic diverted from the project under construction, or using the project under construction and shall provide and maintain in a safe condition temporary approaches to, and crossing, of the project. Existing facilities planned to be removed, but which might be of service to the public during construction, are not to be disturbed until other adequate provisions are made. Existing mailboxes shall be maintained or reset in positions accessible to the public and to mail deliveries during construction and subsequent to construction in their final locations in a satisfactory condition. Fire hydrants on or adjacent to the project shall be kept accessible to fire apparatus at all times,

and no material or obstruction shall be placed within 15 feet of any such hydrant. All footways, gutters, sewer inlets and portions of the project adjoining the work under construction shall not be obstructed more than is absolutely necessary. Work closed down for the winter or at any other times shall be left entirely accessible at all pints to fire apparatus.

GP-7.07 Detours

Detours may be indicated in the contract documents, or at the Contractor's request traffic may be detoured over approved routes along existing roads when acceptable to the Administration's representative. Detours over existing City streets will be designated, marked, and maintained by the City.

GP-7.08 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. All highways and other City facilities closed to vehicular traffic shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness with adequate lights.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the facility by vehicular traffic, and at all other points where the new work crosses or coincides with an existing roadway or traffic lane(s). Such warning signs shall be constructed and erected in accordance with the Manual on Uniform Traffic Control Devices, or as directed.

The Contractor shall furnish, erect, and maintain warning and directive signs in the number required by the Administration's representative and at locations designated by the Administration's representative throughout the limits of the project. For street and highway type traffic, the signs shall conform in every respect to the requirements of the Manual on Uniform Traffic Control Devices for Streets and Highways. Signs must be freshly painted before being placed on any project. No work may be performed or begun unless an adequate number of signs of the proper category are in place.

In cases where the Contractor's sequence of operations results in grade differentials which would be hazardous to vehicular traffic, the Contractor will, at the direction of the Administration's representative, provide suitable substantial guardrail to the extent determined by the Administration's representative.

GP-7.09 Flagging of Motor Vehicle Traffic

For all construction requiring the flagging of motor vehicles for operation on the highways of Maryland, said flagging shall be conducted as specified in the Manual on Uniform Traffic Control for Streets and Highways.

GP-7.10 Maintenance of Traffic

Unless otherwise noted in the Social Provisions, it shall be the Contractor's responsibility to maintain pedestrian and vehicular traffic safety, adequately and continuously on all portions of existing facilities affected by his work. In addition to existing facilities undergoing improvement, this also applies to crossroads, approaches, crossovers and entrances affected or made necessary by his work.

GP-7.11 Preservation and Restoration of Property

The Contractor shall not enter upon public or private property (outside of the right-of-way or project area) for any purpose without obtaining permission and he shall be responsible for the preservation of all public and private property, trees, monuments, signs, and markers and fences thereon, and shall use every precaution necessary to prevent damage or injury thereto.

All City owned signs and markers that are affected by the work shall be carefully removed by Department of Public Works after so informed by the Contractor when grading operations begin. The Contractor shall take suitable precaution to prevent damage to underground or overhead public utility structures, shall protect carefully from disturbances or damages all land monuments and property marks until the Administration's representative has referenced their location, and shall replace them as directed by the Administration's representative.

Special attention shall be given the landscape features of the work and special care taken to protect the natural surroundings. The Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without special authority. The roots of such trees or shrubbery shall not be cut unnecessarily, and no road machinery of any description which might throw off gas or smoke in such volume as to damage vegetation shall be allowed to stand under such trees or shrubbery.

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, omissions, neglect or misconduct in his manner or method of executing said work, or at any time due to defective work or materials, and said responsibility shall not be released until the work shall have been completed and accepted. When or where any direct or indirect damage or injury is done to public or private property by or on the account of any act, omission, neglect or misconduct in the execution of the work or in consequence of the nonexecution thereof on the part of the Contractor, he shall restore, at his own expense, such property to a condition

similar to, or equal to, that existing before such damage or injury, the Administration's representative may, upon 48 hours notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary and the cost thereof will be deducted from monies due or which may become due the Contractor under his contract.

GP-7.12 Land, Air and Water Pollution

The Contractor shall incorporate all permanent erosion control features into the work at the earliest practicable time as required by the contract documents. Temporary pollution control measures will be used to correct conditions that develop during construction that were not foreseen during design; that are needed prior to installation of permanent pollution control design features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

The Contractor's attention is directed to the fact that temporary pollution control measures outside the right-of-way or project site where such work is necessary as a direct result of project construction. The Administration's representative shall be kept advised of all such off-site control measures taken by the Contractor. This shall not relieve the Contractor of basic responsibilities for such work.

In case of failure on the part of the Contractor to control erosion, pollution, and/or siltation, the Administration's representative reserves the right to employ outside assistance or to use its own forces to provide the necessary corrective measures. All expenses incurred by the Administration's representative in the performance of such duties for the Contractor shall be withheld from monies becoming due to the Contractor.

Contractors and suppliers must submit evidence to the Administration that the governing federal, State and local air pollution criteria will be met. This evidence and related documents will be retained by the City for on-site examination.

GP-7.13 Responsibility for Damage Claims

The Contractor shall indemnify and save harmless the City and all of its representatives from all suits, actions, or claims of any character brought on account of any injuries or damages sustained by any person or property in consequence of any neglect in safeguarding the work or through the use of unacceptable materials in the construction of the improvement, or on account of any act or omission by the said Contractor, or as a result of faulty, inadequate or improper temporary drainage during construction, or on account of the use, misuse, storage or handling of explosives, or on account of any claims or amounts recovered from any infringement of patent, trademark, or copyright, or from any claims or amounts arising or recovered under the Workman's Compensation Laws, or any other law, bylaw, ordinance, order or decree. 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 the manner or method of executing said work satisfactorily or due to the nonexecution of said work or at any time due to defective work or materials and said responsibility shall continue until the improvement shall have been completed and accepted.

The Contractor shall conduct his operations upon the right-of-way of any railroad company fully within the rules, regulations, and requirements of the railroad company. The Contractor shall be responsible for acquainting himself with such requirements as the railroad company may demand.

The Contractor shall be held responsible for any accidents that may happen to the railroad company as a result of his operation.

The Contractor shall not be held responsible for any claims arising from accidents incurred because of any traffic and/or general use permitted during the time the project or any section thereof is open to traffic under the terms of GP-7.15 except from accidents which are attributable to his negligence.

GP-7.14 Liability Insurance

Prior to the start of work on any contract, the Contractor shall submit to the Administration's representative a certificate of insurance indicating that he carries comprehensive general public liability and property damage insurance in the amounts specified elsewhere in the contract.

GP-7.15 Use and Possession Prior to Completion

The City shall have the right to take possession of or use any completed or partially completed part of the work. Such possession of or use shall not be deemed an acceptance of any work not completed in accordance with the contract. While the City is in such possession, the Contractor shall be relieved of the responsibility for loss or damage to that portion of the work in possession of the City, other than that resulting from the Contractor's fault or negligence. If such prior possession or use by the City delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment in the contract price or the time of completion will be made and the contract shall be modified in writing accordingly.

GP-7.16 Contractor's Responsibility for Work

Except as herein elsewhere provided, until final acceptance of the work by the City, the Contractor shall have the charge and care thereof and shall take every reasonable 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 nonexecution of the work. The Contractor, except as herein elsewhere provided, 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. Material lost or structures damaged as a result of faulty temporary drainage during construction or the action of the elements shall be replaced or repaired by the Contractor at no cost to the City. The Contractor shall make good or replace at his own expense and as required and City furnished material which may be broken, lost through fire, theft, or otherwise damaged or in any way, made useless for the purpose and use intended subsequent to delivery to the Contractor by the City and prior to final acceptance of the work even though such breakage, damage, loss or uselessness may result from causes beyond the control of the Contractor.

In the case of suspension of work for 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 work, provide for normal drainage and shall erect any necessary temporary structures, signs, or other facilities at his expense. 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 his contract, and shall take adequate precaution to protect new growth and other important vegetative growth against injury.

GP-7.17 Contractor's Responsibility for Utility Property and Services

At points where the Contractor's operations are adjacent to properties of railway, telegraph, telephone, and power companies, or are adjacent to other property, damage to which might result in expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made by the Contractor.

The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication or rearrangement work may be reduced to a minimum and that services rendered by those parties will not be unnecessarily interrupted.

It shall be the Contractor's responsibility to support and protect all public utilities such as pipes, conduits, and other structures which will remain in place and in service during the term of and the contract as indicated on the plans; also, all others which may be uncovered during construction or which may be installed by others during construction; and to meet all other conditions which may be encountered during the construction. In case of damage to any such pipes, conduits, or other structures, the Contractor shall, at his entire cost and expense, restore such utilities to a condition equal to that which existed before the damage was done.

In the event of interruption to utility services as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service.

Should the location or positions of any gas or water pipe, public or private sewer, conduit or other structure be such as, in the opinion of the Administration's representative, to require its removal, realignment, or change, such change shall be accomplished without cost to the Contractor. Such structure shall be stripped, exposed or uncovered and supported and sustained by the Contractor, at his own cost and expense, and constituting a part of the contract, before removal or before and after realignment and change. The Contractor shall not become entitled to claim any damage or extra compensation from or on account of the presence of such structure, or on account of any delay in the removal, realignment or rearrangement of the same; but the Contractor shall be entitled to such as extension of time for the completion of the Contract as the Engineer shall decide that the work has been delayed, by any delay in the removal, realignment or change of any such obstruction.

No work shall be undertaken around fire hydrants until provisions for continued service has been approved by the Department of Public Works.

GP-7.18 Personal Liability of Public Officials

In carrying out any of the provisions of the contract, or in exercising any power of authority granted to them by or within the scope of the contract, there shall be no liability upon the City, Administration's representative, or other authorized representative, either personally or as officials of the City, it being understood that in all such matters they act solely as agents and representatives of the City.

GP-7.19 No Waiver of Legal Right

The City shall not be precluded or stopped by any measurement, estimated, or certificate made either before or after the completion and acceptance of the work and payment therefore, from showing the true amount and character of the work performed and materials furnished by the Contractor, nor from showing that any such measurement, estimate or certificate is untrue or is incorrectly made, nor from showing that the work or materials do not in fact conform to the contract. The City shall not be precluded or stopped, notwithstanding any such measurement, estimate, or certificate and payment in accordance therewith, from recovering from the Contractor or his sureties, or both, such damage as it may sustain by reason of his failure to comply with the terms of the contract. Neither the acceptance by the City or any representative of the City nor any payment for or acceptance of the whole or any part of the work, nor any extension of time, nor any possession taken by the City shall operate as a waiver of any portion of the contract or of any power herein reserved, or of any right to damages.

The waiver of any breach of the contract shall not be held to be a waiver of any other subsequent breach.

GP-7.20 Nondiscrimination

In accordance with the requirements of Section 3-406 of Article 21 of the Annotated Code of Maryland, the Contractor agrees that he will not discriminate in any manner against any employee or applicant for employment because of political or religious opinion or affiliation, sex, race, creed, color or national or origin. The Contractor further agrees that he will comply with any additional requirements with respect to nondiscrimination which may be imposed by amendment to Section 3-406. The Contractor agrees to include a similar clause or clauses with respect to nondiscrimination in all subcontracts, except subcontracts for standard commercial supplies or raw material. The Contractor and subcontractor or subcontractors agree to post in conspicuous places, available to employees and applicants for employment, notices setting for the provisions of the no discrimination clause or clauses.

Failure by the Contractor or subcontractor(s) to include the contract provisions or to comply with the nondiscrimination provision set forth above shall be grounds for the City to exercise its remedies pursuant of Section 3-405.

Contractor agrees that he will comply with the Civil Rights Act of 1964 and Section 202 of Executive Order 11246 of the President of the United States of America as mended by Executive Order 11375, as applicable.

The Contractor further agrees that he will comply with any additional provisions as to nondiscrimination which may be specified elsewhere in the contract documents.

GP-7.21 Sanctions Upon Improper Acts

In the event that Contractor, or any of its officers, partners, principals, or employees, is convicted of a crime arising out of, or in connection with, the procurement of work to be done or payment to be made under this contract, the contract may, in discretion of the City be terminated.

Section 3-405 of Article 21 of the Annotated Code of Maryland which relates to contracts with persons convicted of bribery, attempted bribery or conspiracy to bribe are incorporated in this contract by reference.

Section 3-404 of Article 21 of the Annotated Code of Maryland relating to disqualification for unfair labor practices, are incorporated into this contract by reference.

Section 3-901 of Article 21 of Annotated Code of Maryland relating to collusion for purposes of defrauding the City, are incorporated into this contract by reference.

GP-7.22 Non-Hiring of Employees

No employee of the City of Frederick, or any department, commission, agency or branch thereof whose duties as such employees include matters relating to or affecting the subject matter or this contract, shall while such employee become or be an employee of the party or parties hereby contracting with said City of Frederick, or any department, commission, agency, or branch thereof.

GP-7.23 Choice of Law

The parties hereby agree that:

- A. This contract **was made and entered into in Maryland, under the laws of Maryland.**
- B. The law of Maryland **shall govern the resolution of any issue arising in connection with this contract, including but not limited to, all questions concerning the validity of this contract, the capacity of the parties to enter therein, any modification or amendment thereto and the rights and obligations of the parties hereunder.**

GP-7.24 Contingent Fee Prohibition

The Contractor warrants that he has not employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee or agent working for him, to solicit or secure this contract, and that he has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee or agent, any fee or any other consideration contingent on the making of this contract.

GP-7.25 Multi-Year Contracts Contingent Upon Appropriations

This contract is subject to termination for the convenience of the City funds are not appropriated for any fiscal year for the future performance of the contract.

GP-7.26 Cost and Price Certification

The Contractor shall submit cost or price information and shall certify that, to the best of his knowledge, the information submitted is accurate, complete and current as of a mutually determined specified date prior to the date the price of any:

- (1) **Negotiated contract is determined, if the total contract price is expected to exceed one hundred thousand dollars (\$100,000), or a smaller amount set by the Administration's representative.**
- (2) **Change order or contract modification is determined which is expected to exceed one hundred thousand dollars (\$100,000), or a smaller amount set by the Administration's representative.**

The price, including profit or fee, shall be adjusted to exclude any significant price increase occurring because the Contractor furnished cost or price information, which as of the date agreed upon between the parties, was inaccurate, incomplete or not current.

The Contractor or subcontractor shall maintain books and records that relate to the cost or pricing data for three years from the date of final payment under the contract, unless a different period is otherwise authorized in the contract.

GP-7.27 Corporate Registration and Tax Payment Certification

Corporations are required to execute a Certification of Corporation Registration and Tax Payment in the form included in the contract documents.

GP-7.28 Buy American Steel Act

The Provisions of Title 8 of Article 21 of the Annotated Code of Maryland, pertaining to implementation of the "Buy American Steel" Act, are incorporated in this contract by reference.

GP-7.29 Minority Business Enterprise

The City is pursuing an Affirmative Action Program to insure equal opportunity in its project bidding and awards practice. We are asking you to help us in this effort by completing the Applicant Affirmative Action Data Form. Completing the Data Form will assist us in monitoring the effectiveness of our program. This form will be filed separately from your bid proposal and will not be used to discriminate in any way in the project bidding or award process. The completion of this form is optional and is not required for your participation and consideration; however, your cooperation is appreciated.

GP – SECTION 8

PROSECUTION AND PROGRESS

GP-8.01 Subcontracting

Except as may be provided elsewhere in the contract, the Contractor to whom a contract is awarded shall perform with his own organization and with the assistance of workman under his immediate supervision, work of a value of not less than 50 percent of the total original value of the contract.

No portion of the contract shall be subcontracted, assigned or otherwise disposed of except with the written consent of the Administration's representative and of the surety. Consent to subcontract, assign or otherwise dispose of any portion shall not be construed to relieve the Contractor or surety or any responsibility for the fulfilling of all the requirements of the contract.

GP-8.02 Notice to Proceed

After the contract has been executed, the City will, within the time limit specified by the City elsewhere in the contract documents, issue to the Contractor a "Notice to Proceed" and this notice will stipulate the date on or before which the Contractor is expected to begin work. The specified contract time shall begin on the day work (other than the erection of the inspector's office, construction stakeout, and mobilization) actually starts or on the day stipulated in the "Notice to Proceed", whichever is earlier. Any preliminary work started, or materials ordered, before receipt of the "Notice to Proceed", shall be at the risk of the Contractor.

GP-8.03 Prosecution of the Work

The Contractor shall begin work promptly within the time specified by the Administration's representative and shall notify the Administration's representative at least 48 hours before starting work.

After the work has once been started, it shall be prosecuted continuously on all acceptable working days without stoppage until the entire contract is complete.

Should the prosecution of the work for any reason be discontinued, the Contractor shall notify the Administration's representative of his intention to stop and shall also notify the Administration's representative at least 24

hours in advance of resuming operations. Said notification shall be confirmed in writing.

GP-8.04 Progress Schedule

Within 10 days after notice to proceed, the Contractor shall furnish the Administration's representative a "Progress Schedule" showing the proposed order of work and indicating the time required for the completion of the work. Said progress schedule shall be used to establish major construction operations and to check on the progress of the work. The Contractor shall submit revised progress schedules as directed by the Administration's representative.

If the Contractor fails to submit the progress schedule within the time prescribed, or the revised schedule within the requested time, the Administration's representative may withhold approval of progress payment estimates until such time as the Contractor submits the required progress schedules.

If, in the opinion of the Administration's representative, the Contractor falls significantly behind the approved progress schedule, the Contractor shall take any and all steps necessary to improve his progress. To accomplish this action may require the Contractor to increase the number of shifts, initiate or increase overtime operations, increase days of work in the work week, or increase the amount of construction plants, or all of them. The Administration's representative may also require the Contractor to submit for approval supplemental progress schedules detailing the specific operational changes to be instituted to regain the approved schedule, all without additional cost to the City.

Failure of the Contractor to comply with the requirements of the Administration's representative under this provision shall be grounds for determination by the Administration's representative that the Contractor is not prosecuting the work with such diligence as will insure completion within the time specified. Upon such determination, the Administration's representative may terminate the Contractor's right to proceed with the work, or any separable part thereof, in accordance with GP-8.08 of these General Provisions.

GP-8.05 Limitations 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 the public.

GP-8.06 Character of Workmen, Methods and Equipment

The Contractor shall employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the contract.

Workmen must have sufficient skill and experience to perform properly the work assigned to them. All workmen engaged in special work or skilled work shall

have sufficient experience in such work and in operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or by any subcontractor who, in the opinion of the Administration's representative, does not perform his work in a proper manner or is intemperate or disorderly shall, at the written request of the Administration's representative, be removed forthwith by the Contractor or subcontractor employing such foreman or workman, and shall not be employed again in any portion of the work without the approval of the Administration's representative.

Should the Contractor fail to remove such person or persons required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Administration's representative may withhold estimates which are or become due on the contract until a satisfactory understanding has been reached.

Equipment to be used on the work shall meet the requirements of the work and produce a satisfactory quality of work. The Administration's representative may order the removal and require replacement of any unsatisfactory equipment.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed in the contract, the Contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the Administration's representative will accomplish the contract work in conformity with the requirements of the contract.

When the contract specifies the construction be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Administration's representative in writing. If the Contractor desires to use a method or type of equipment other than those specified in the contract, he may request authority from the Administration's representative to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation 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 construction work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the Administration's representative determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substituted method or equipment and shall complete the remaining construction 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 Administration's representative may direct. No change will be made in basis of payment for the construction items involved nor in contract time as the result of authorizing a change in methods or equipment under these provisions.

GP-8.07 Suspensions of Work

The Administration's representative may order the Contractor in writing to suspend, delay, or interrupt all or any part of the work for a period of time as he may determine to be appropriate for the convenience of the City.

If the performance of all or any part of the work is for an unreasonable period of time, suspended, delayed, or interrupted by act of the Administration's representative in the administration of this contract, or by his failure to act within the time specified in this contract (or if no time is specified, within a reasonable time), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by an unreasonable suspension, delay, or interruption and the contract modified in writing accordingly. However, no adjustment shall be made under this clause 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 for or excluded under and other provisions of this contract.

No claim under this clause shall be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Administration's representative 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 a suspension, delay, or interruption, but not later than the date of final payment under the contract.

GP-8.08 Termination for Default – Damages for Delay – Time Extensions

If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as shall insure its completion within the time specified in this contract, or any extension thereof, or fails to complete said work within this time, the City may, by written notice to the Contractor, terminate his right to proceed with this work or the part of work as to which there has been a delay. In this event, the City 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, the materials, appliances, and plan as 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 damage to the City 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 City so terminates the Contractor's right to proceed, the resulting damage shall consist of such liquidated damages until a reasonable time as may be required for final completion of the work together with any increased costs occasioned the City in completing the work.

If fixed and agreed liquidated damages are provided in the contract and if the City does not so terminate the Contractor's right to proceed the resulting damage shall consist of these liquidated damages until the work is completed or accepted.

The Contractor's right to proceed may not be so terminated nor the Contractor charged with resulting damages 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 public enemy, acts of the City in either its sovereign or contractual capacity, acts of another contractor in the performance of a contract with the City, fires, floods, epidemics, quarantine restrictions, strikes, freight embargos, unusually sever weather, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and
- (2) The Contractor, within ten days from the beginning of any such delay (unless the Administration's representative grants a further period of time before the date of final payment under the contract), notifies the Administration's representative in writing of the causes of delay. The Administration's representative shall ascertain the facts and the extent of the delay and extend the time for completing the work when, in his judgment, 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 the "Disputes" claims of this contract.

If, after notice of termination of the Contractor's right to proceed under the provisions of this clause, it is determined for any reason that the Contractor was not in default under the provisions of this clause, or that the delay was excusable under the provisions of this clause, the rights and obligations of the parties shall, if the contract contains a clause providing for termination for convenience of the City, be same as if the notice of termination has been issued pursuant to the clause. If, in the foregoing circumstances, this contract does not contain a clause providing for termination for convenience of the City, the contract shall be equitably adjusted to compensate for the termination and the contract modified accordingly; failure to agree to any such adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes".

The rights and remedies of the City provided in this clause are in addition to any other rights and remedies provided by law or under this contract.

As used in this clause, the term "subcontractors or suppliers" means subcontractors or suppliers at any tier.

GP-8.09 Liquidated Damages

Time is an essential element of the contract and it is important that the work be vigorously prosecuted until completion.

For each day that any work shall remain uncompleted beyond the time(s) specified elsewhere in the contract, the Contractor shall be liable for liquidated damages in the amount(s) provided for in the solicitation, provided, however, that due account shall be taken of any adjustment of specified completion time(s) for completion of work as granted by approved change orders.

GP-8.10 Termination for Convenience of the City

The performance of work under this contract may be terminated by the City in accordance with this clause in whole, or from time to time in part, whenever the Administration's representative shall determine that such termination is in the best interest of the City. Any such termination shall be affected 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.

After receipt of a Notice of Termination, and except as otherwise directed by the Administration's representative, 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 the 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 Notice of Termination;**
- (4) Assign to the City in the manner, at the times, and to the extent directed by the Administration's representative, all of the right, title, and interest of the Contractor under the orders and subcontracts so terminated, in which case the City shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders, and subcontract;**
- (5) Settle all outstanding liabilities and all claims arising out of the termination of orders and subcontracts, with the approval or ratification of the Administration's representative, to the extent he may require, which approval or ratification shall be final for all the purposes of this clause;**
- (6) Transfer title and deliver to the City, in the manner, at the times, and to the extent, if any, directed by the Administration's representative (a) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced 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 has been completed, would have been required to be furnished to the City;

- (7) Use his best effort to sell, in the manner, at the time, to the extent, and at the price or prices directed or authorized by the Administration's representative, 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 purchaser and (b) may acquire any such property under the conditions prescribed by and at a price or prices approved by the Administration's representative; and provided further that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the City to the Contractor under this contract or shall otherwise be credited to the price or cost of the work covered by this contract or paid in such other manner as the Administration's representative may direct;
- (8) Complete performance of such part of the work as may not have been terminated by the Notice of Termination; and
- (9) Take such action as may be necessary, or as the Administration's representative may direct, for the protection and preservation of the property related to this contract which is in the possession of the Contractor and in which the City has or may acquire an interest. The Contractor may submit to the Administration's representative 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 Administration's representative, and may request the City to remove such items or enter into a storage agreement covering them. Not later than 15 days thereafter, the City shall 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 Administration's representative 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 adjustment to correct the list as submitted shall be made prior to final settlement.

After receipt of a Notice of Termination, the Contractor shall submit to the Administration's representative his termination claim, in the form and with certification prescribed by the Administration's representative. 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 Administrations representative, upon request of the

Contractor made in writing within such one year period or authorized extension thereof. However, if the Administration's representative 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 any extension thereof. Upon failure of the Contractor to submit his termination claim within the time allowed, the Administration's representative may determine, on the basis of information available to him, the amount, if any, due to the Contractor by reason of the

termination and shall thereupon pay to the Contractor the amount so determined.

Subject to the provisions of the paragraph above, the Contractor and the Administration's representative 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 clause, 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 the total contract price as reduced by the contract price or work not terminated. The contract shall be amended accordingly, and the Contractor shall be paid the agreed amount. Nothing in the following paragraph of this clause, prescribing the amount to be paid to the Contractor in the event of failure of the Contractor and the Administration's representative to agree upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this clause, shall be deemed to limit, restrict, or otherwise determine or affect the amount or amounts which may be agreed upon to be paid to the Contractor pursuant to this paragraph.

In the event of the failure of the Contractor and Administration's representative to agree, as provided in the paragraph above upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this clause, the Administration's representative shall pay to the Contractor the amounts determined by the Administration's representative as follows, but without duplication of any amounts agreed upon in accordance with the paragraph above.

- (1) With respect to all contract work performed before the effective date of the Notice of Termination, the total (without duplication of any items) of:
 - a) The cost of the work;
 - b) The cost of settling and paying claims arising out of the termination of work under subcontracts or orders as provided in this clause, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by the subcontractor before the effective date of the Notice of Termination of Work under this contract, which amounts shall be included in the cost on account of which payment is made under (a) above; and
 - c) A sum as profit on (a) above, determined by the Administration's representative, 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 completed, no profit shall be included or allowed under this subdivision, and an appropriate adjustment shall be made reducing the amount of the settlement to reflect the indicated rate of loss; and
- (2) The reasonable cost of the preservation and protection of property, incurred pursuant to this clause, and any other reasonable cost incidental to termination of work under this contract, including expense incidental to

the determination of the amount due to the Contractor as the result of the termination of work under this contract.

The total sum to be paid to the Contractor under (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 City shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor under (1) above, the fair value, as determined by the Administration's representative, of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to the City or to a buyer pursuant to this clause.

The Contractor shall have the right of appeal, under the clause of this contract entitled "Disputes", from any determination made by the Administration's representative under this clause, except that if the Contractor has failed to submit his claim within the time provided for above, and has failed to request extension of such time, he shall have no such right of appeal. In any case, where the Administration's representative has made a determination of the amount due under this clause, the City shall pay to the Contractor the following: (a) if there is not right of appeal hereunder or if no timely appeal has been taken, the amount so determined by the Administration's representative or (b) if an appeal has been taken, the amount finally determined on such appeal.

In arriving at the amount due the Contractor under this clause, there shall be deducted (a) all unliquidated advance or other payments or account theretofore made to the Contractor, applicable to the terminated portion of this contract, (b) any claim which the City may have against the Contractor in connection with this contract and (c) the agreed price for, or the proceeds of, sale of any materials, supplies, or other things acquired by the Contractor or sold, pursuant to the provisions of this clause, and not otherwise recovered by or credited to the City.

If the termination hereunder be partial, the Contractor may file with the Administration's representative a claim for an equitable adjustment of the price of 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 adjustments as may be agreed upon shall be made in such price or prices. Any claim by the Contractor for an equitable adjustment under this clause shall be asserted within 90 days from the effective date of the termination notice, unless an extension is granted in writing by Administration's representative.

The City may, from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against costs incurred by the Contractor in connection with the terminated portion of this contract whenever, in the opinion of the Administration's representative, the aggregate of such payments shall be within the amount to which the Contractor shall be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this cause, such excess shall be payable by the Contractor to the City upon

demand, together with interest computed at a legal rate for period from the date such excess payment is received by the Contractor to the date on which the excess is repaid to the City; provided, however, that no interest shall be charged with Contractor's claim by reason of retention or other disposition of termination inventory until 10 days after the date of the retention of disposition, or a later date as determined by the Administration's representative by reason of the circumstances.

Unless otherwise provided for in this contract, or by applicable statute, the Contractor shall from the effective date of termination until the expiration of three years after final settlement under this contract, preserve and make available to the City at all reasonable times at the office of the Contractor but without direct charge to the City, all his books, records, documents and other evidence bearing on the costs and expenses of the Contractor under this contract and relating to the work terminated hereunder, or, to the extent approved by the Administration's representative, photographs, microphotographs, or other authentic reproduction thereof.

GP-8.11 Successful Termination of Contractor's Responsibility

A contract will be considered as successfully fulfilled when the work has been completed in accordance with the terms of the contract, when final acceptance has occurred, when final payment has been authorized, when all of the obligations of the Contractor and his surety have been complied with, and when final payment has been made.

GP – SECTION 9

PAYMENT

GP-9.01 Scope of Payment

Payment to the Contractor will be made for the actual quantities of contract items performed in accordance with the plans and specifications and if, upon completion of the construction, these actual quantities show either an increase or decrease from the quantities given in the bid schedule, the contract unit prices will still prevail, except as provided in GP-4.01, “Variations in Estimated Quantities”.

The payment of any partial estimate or of any retained percentage except by under the approved final estimate and voucher, in no way shall affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damages due to such defects.

When requested in writing by the Contractor and approved by the Administration’s representative, payment allowance will be made for nonperishable material to be incorporated in the work delivered and stockpiled at the work site or other approved site. Material for which payment has been made, wholly or partially, shall not be removed from the work site or other approved site.

Payment to the Contractor under this section for materials on hand in no way will be construed as acceptance by the City of title to the material. Title shall remain with the Contractor until the project has been completed and accepted in accordance with GP-5.13.

Contractor shall indicate his Federal Tax Identification or Social Security number on the face of each invoice billed to the City.

GP-9.02 Force Account Work

When the Contractor is required to perform work as a result of additions or changes to the contract, the City and Contractor shall make every effort to come to an agreed upon price for the performance of such work. If an agreement cannot be reached, the City may require the Contractor to do such work on a force account basis to be compensated in accordance with the following:

A. Labor

For all labor and for foremen in direct charge of the specific operations, the Contractor shall receive the actual wages for each and every hour that said labor and foremen are actually engaged in such work.

The Contractor shall receive the actual costs paid to, or in behalf of, workmen by the reason of subsistence and travel allowances, health and welfare benefits, pension fund benefits or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the work.

B. Materials

For materials accepted by the Administration's representative and used, the Contractor shall receive the actual cost of such materials delivered on the work, including transportation charges paid by him (exclusive of machinery rentals as hereinafter set forth).

C. Equipment

For any machinery or special equipment (other than small tools, whether rented or owned), the use of which has been authorized by the Administration's representative, the Contractor shall receive the rates agreed upon in writing before such work is begun, or the Contractor shall receive those rates which may be specified elsewhere in the Special Provisions. For the purpose of definition, equipment with a new cost of five hundred dollars (\$500) or less will be considered small tools.

D. Materials and Supplies Not Incorporated in the Work

For materials and supplies expended in the performance of the work (excluding those required for rented equipment) and approved by the Administration's representative, the Contractor shall receive the actual cost of such materials and supplies used. The Contractor shall receive a reasonable allowance for material used but not expended in the performance of the work.

E. Bond, Insurance, and Tax

For bond premiums, property damage, liability, and workmen's compensation insurance premiums, unemployment insurance contributions, and social security taxes on the force account work, the Contractor and Administration's representative shall determine an equitable percent to be applied against the labor cost (premium pay and fringes excluded).

F. Subcontractors

The contract shall receive the actual cost of work performed by a subcontractor. Cost is to be determined as in A, B, C, D, and E above, plus the fixed fee for overhead and profit allowance computed as in H.

G. Superintendence

No additional allowance shall be made for general superintendence the use of small tools, or other costs for which no specific allowance is herein provided.

H. Contractor's Fixed Fee

The Administration's representative and the Contractor shall negotiate a fixed fee for force account work performed pursuant to this GP-9.02 by his forces and by his subcontractor(s) as compensation for overhead and profit for the work performed. Failure of the Contractor and the Administration's representative to negotiate a fixed fee consistent with applicable cost principles shall be treated as a dispute pursuant to GP- 5.15 and the Contractor shall proceed diligently with the performance of the force account work to completion. In no event shall a contractor's fixed fee exceed an amount equal to the sum of 15 percent of A and 10 percent of B plus 5 percent of C and D above. In addition, the Contractor's fixed fee may include an amount not to exceed 5 percent of subcontractor's labor and material costs as defined in A and B above.

I. Compensation

The compensation as set forth above shall be received by the Contractors payment in full for change order work, done on a force account basis. At the end of each day, the Contractor's representative and the Administration's representative shall compare records of the cost of work as ordered on a force account basis.

J. Statements

No payment will be made for work performed on a force account basis until the Contractor furnishes the Administration representative duplicate itemized statements of the cost of such force account work detailed as to the following:

- (1) Name, classification, date, daily hours, rental rate, and extension for each unit of machinery and equipment.**
- (2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.**
- (3) Quantities of material, prices and extensions.**
- (4) Transportation of materials.**
- (5) Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.**

- (6) **Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.**
- (7) **Payment of items under paragraphs (3) and (4), shall be accompanied by original receipted invoices for materials used and transportation charges. If, however, the materials used in the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the original invoices, the statements shall contain or be accompanied by an affidavit of the Contractor which shall certify that such materials were taken from his stock, that the quantity claimed was actually used, and that the price and transportation of the material as claimed represent actual cost.**

GP-9.03 Partial Payments

A. Current Estimates

- (1) **Lump Sum Contracts. If requested by the City, the Contractor shall furnish an acceptable breakdown of the lump sum contract price showing the amount included therein for each principal category of the work. Said breakdown shall be in such detail so as to provide a basis for estimating monthly progress payments.**
- (2) **Monthly Estimates. Each month, the City will pay the Contractor for the contract value or the work satisfactorily performed during the preceding calendar month, less 10 percent. When such 10 percent retainage amounts to 5 percent of the total contract value, including authorized extras and additions, no further retainage will be deducted from monthly payments due the Contractor. The 5 percent of the total contract value retained by the City will not be released until final payment (unless partially released in a semi-final payment). Current estimates will be based upon the Administration's representative estimate of quantity (including materials and/or equipment complete in place) satisfactorily performed. In the instance of lump sum items, the Administration's representative estimate shall be the proper fraction of the lump sum item satisfactorily performed during preceding month. All quantities, estimates, and fractions will reasonably accurate approximations and are subject to correction (a) in subsequent current estimates, (b) in any semi-final estimate and (c) in final payment. Any and/or all partial payments may be withheld in the event current requirements of the specifications have not been complied with by the Contractor. Should either the Administration's representative or the Contractor be of the opinion that any estimates, quantities and/or fractions (either as to an individual current estimate or accumulations thereof) do not represent a reasonably accurate approximation of actual work, then details questioned shall be reviewed and then any corrections adjusted for in the next current estimate.**

B. Semi-Final Estimate Payments

- (1) Upon completion of the project and the acceptance by the City of the project for maintenance, the City, at the Contractor's request and with consent of surety, will pay the Contractor, within 30 calendar days of said request, what is hereby known as a semi-final estimate payment. Such a semi-final estimate payment will be based upon (a) quantities computed by the City and set up as proposed final quantities and (b) a reasonably accurate estimate for those quantities for which the City has not yet completed computations. The quantities which the City sets forth as proposed final quantities shall be so designated. To arrive at the amount of semi-final estimate payment, there shall be deducted from the apparent estimated value of the contract (a) total of amounts previously paid to the Contractor as current estimates and (b) sums deemed chargeable against the Contractor properly deductible including liquidated damages, and as a retainage a sum not less than 2 percent of the total value of the contract.
- (2) In cases where there has been substantial completion of the project and there are remaining only inconsequential or minor work items such as painting, seeding, mulching, or planting to be completed and such items cannot be completed for an extended period of time because of seasonal or weather conditions, there shall be made a semi-final inspection and if the work completed is found by the Administration to be satisfactory, then there is deemed to be partial acceptance on the entire project except for the uncompleted work items. Upon the above referred to partial acceptance the City within 30 days from such partial acceptance, upon request of the Contractor and with consent of surety, shall pay to the Contractor what is hereby know as partial semi-final estimate payment. Such a semi-final estimate will be based upon (a) quantities the City has computed and set up as proposed final quantities and (b) a reasonably accurate estimate for those quantities for which the City has not yet completed computations. The quantities which the City sets forth as proposed final quantities shall be so designated. To arrive at the amount of semi-final estimate payment, there shall be deducted from the apparent estimated value of the contract (a) total of all amounts previously paid to the Contractor as current estimate and (b) sums deemed chargeable against the contractor properly deductible including liquidated damages, and as a retainage a sum equal to 2 percent of the total value of the contract. (Said retainage is not to be less than two thousand dollars [\$2,000]).

GP-9.04 Acceptance and Final Payment

- A. When the Contractor has completed a contract and it has been finally accepted, in accordance with the provisions of GP-5.13, the City will promptly proceed (a) to make any necessary final surveys, (b) to complete any necessary computation of quantities and (c) to submit to the Contractor within 60 days after final completion and acceptance of the project by the

Administration's representative for maintenance for his consideration a tabulation of the proposed final quantities. This tabulation shall be accompanied by a statement setting forth (a) the additional work performed under change orders and/or supplemental agreements, (b) the authorized extension of time, (c) the number of days which have been charged against the Contractor as having been used to complete the contract, and (d) any deductions, charges or liquidated damages which have been made or imposed.

- B. The Contractor shall then have a period of 10 calendar days, dating from the date upon which he received the aforementioned tabulation from the City, in which to (a) decide whether or not he will accept final payment upon such a basis, and (b) notify the City, in writing, of his decision. The Contractor may request an additional period up to 10 calendar days in which to notify the City of his decision. In the event the Contractor notifies the City that he protests final payment on such a basis, that notification shall outline the reason(s) for said protest.
- C. Upon receipt of a notification of acceptance as provided for in paragraph (B) above, the City shall prepare the final estimate and final payment forms and submit them to the Contractor. These forms shall show all data noted in paragraph (A) above, together with deductions for all prior payments. The Contractor shall execute these forms and return them to the City within 30 calendar days from the date they are received for execution and payment. If such signed forms are not received by the City within the specified time, the City will prepare duplicate forms for execution and payment. Such action by the City shall be deemed to constitute acceptance and final payment.
- D. In addition to executing final estimate and payment forms as provided in paragraph (C) above, the Contractor shall submit to the City a "release of lien" form guaranteeing that there are no liens or claims outstanding by any subcontractors involved in the work.
- E. If, under the provisions of paragraph B above, the Contractor notifies the City of his protest and nonacceptance of the data submitted to him, the City shall pay the Contractor a semi-final estimate, or an additional semi-final estimate in the event a semi-final estimate has already been paid based upon the data noted in paragraph (A) above with deductions for all prior payments and a retainage equal to 1-1/2 percent of the total value of the contract. The acceptance of such semi-final

estimate, or additional semi-final estimate, shall not be considered as a waiver on the part of the Contractor of his right to pursue his protest and press for acceptance and final payment.

- F. In the event the Contractor does not accept the data submitted to him as described in paragraph (A) above and/or has outstanding a claim filed in accordance with GP-5.14, **the Administration's representative and the Contractor shall confer at mutual convenient times and endeavor to reconcile all points of disagreement expeditiously. If such reconciliation is accomplished, the City will promptly proceed with acceptance and final payment on the reconciled basis and in accordance with provisions of paragraph (C) above.**

If reconciliation is not accomplished within 30 days, the decision of the Administration's representative shall be reviewed by the City administrator and appropriate legal counsel. After review by the administrator, the decision of the Administration's representative is deemed to be the final action. The Administration's representative shall furnish a copy of the final decision to the Contractor by certified mail, return receipt requested. This decision may be appealed by the Contractor to the Maryland State Board of Contract Appeals Board within 30 days from the date of the final decision. Failure to provide timely notification to the Administration's representative shall constitute a waiver by the Contractor of his right under the Dispute Clause and final payment may be made by the City based on the Administration's representative's recommendation.

- G. All prior partial estimates and payments **shall be subject to correction at the time of acceptance and final payment and if the Contractor has been previously overpaid, the amount of such overpayment shall be set forth in the Final Payment forms and the Contractor hereby agrees that he will reimburse the City for such overpayment within six months of receipt of such advice, and his surety will not be granted release from obligations under the terms of the contract until reimbursement has been made in full.**
- H. Payment for the full apparent value of the contract thus determined **shall become due and payable to the Contractor within 90 days after acceptance of the project by the Administration's representative for maintenance, as hereinafter provided. As a condition precedent to final payment the Contractor shall be required to execute a general release of all claims against the City arising out of, or in any way connected with, this contract.**
- I. In accordance with Article 19, Section 19 of the Annotated Code of Maryland, **certification must be obtained from the Comptroller of the Treasury and the Employment Security Administration, that all taxes have been paid prior to release of final payment on construction contract. Accordingly, when a request is received for final payment the amount of five thousand dollars (\$5,000) or more, or when a request is received which will cause the amount received for payment to fall below five thousand dollars (\$5,000), the City must identify these transactions which will necessitate the Comptroller of the Treasury and the Employment Security Administration to determine whether or not there is any State tax owed by the vendor. The**

check will be processed and mailed only after notification is received from both departments that no State tax is owed.

PART II

GENERAL PROVISIONS AND CONSTRUCTION CONTRACTS

DIVISION 1

GENERAL REQUIREMENTS

| <u>SECTION NUMBER</u> | <u>TITLE</u> | <u>SHEET</u> |
|-----------------------|--|---------------------------|
| 01101 | DEFINITIONS | 01101-1 To 01101-4 |
| 01102 | SITE CONDITIONS, PLANS AND SPECIAL PROVISIONS | 01102-1 To 01102-6 |
| 01103 | MATERIAL SOURCES, SAMPLES AND TESTS | 01103-1 To 01103-3 |
| 01104 | RESTRICTIONS AND PERMITS | 01104-1 To 01104-9 |

SECTION 01101

DEFINITIONS

Additional Work – Increase in quantities of work above those shown in the Proposal Form.

Administration – The City of Frederick, acting through its authorized representatives at agency, department, or executive level.

As-Built – Field conditions as they appear after all construction has taken place and City forces have approved and recommended the site for final acceptance.

Base Course – The layer or layers of specified selected material of designed thickness placed on a subbase or a subgrade to support a surface course.

Bridge – Any bridge or highway grade separation structure shall embrace the substructure and the approaches thereto, and such entrance plazas, interchanges, overpasses, underpasses, connecting highways and other structures with the Administration may deem necessary in connection therewith, together with all property rights, easements, franchises and interests acquired by the Administration for the construction and operation of such bridge.

For the convenience of and definition by the Administration, a bridge will also be known as a structure more than 20 feet in length. The Administration's definition of length shall be the out to out dimension of the floor or from back wall to back wall of abutments. For arches, the length shall be the clear span. For box culverts and batteries of pipes, the length shall be out to out of outer walls and out to out of shells of outside pipes. For lengths, all dimensions shall be parallel to the centerline of the roadway. The dimensions of handrails will not be taken into account in measuring bridge lengths.

Culvert – Any structure not classified as a bridge which provides an opening under any roadway.

Domestic Manufacture – When referring to metallic items such as structural steel, pipe, reinforcement, bridge rails, etc., the term "Domestic Manufacture" is intended to mean those metals whose final alloying has taken place within the confines of the Continental United States.

Drainage Ditch – In general, any open water course other than gutters, constructed beyond the limits of cut or fill slopes for excavation or embankment as indicated by the typical section shown on the plans.

Engineer – The City of Frederick's authorized approving agency or designated representative.

Equipment – All machinery, tools and apparatus necessary for the proper construction and acceptable completion of the work, together with the necessary supplies for upkeep and maintenance.

Extra Work – Work which was not provided for in the original contract.

Extra Work Order – A special form covering extra work, the performance of said extra work or furnishing of materials involving extra work. Such work may be performed at agreed prices or on a force account basis as provided elsewhere herein.

Federal Agencies – Whenever, in these Specifications, reference is made to any Federal agency or officer, such reference shall be deemed made to any agency or officer succeeding in accordance with law to the powers, duties, jurisdictions and authority of the agency or officer mentioned.

Holidays – Holidays occur on:

New Year's Day – January 1

Martin Luther King Day – January 15, if Monday, if not, first Monday following the 15th.

George Washington's Birthday – 3rd Monday of February

Good Friday – (City Only)

Memorial Day – May 30

Independence Day – July 4

Labor Day – 1st Monday in September

Fair Day – Friday during Fair Week (City Only)

Veterans Day – November 11

Thanksgiving Day

Friday after Thanksgiving (City Only)

Christmas Day – December 25

If a legal holiday falls on a Sunday, the Monday next following shall be deemed and treated as a holiday, or as designated by the City.

If a legal holiday falls on a Saturday, the Friday immediately preceding shall be deemed and treated as a holiday, or as designated by the City.

Invitation for Bids – The advertisement of proposals for all work and/or materials on which bids are required. Such advertisement will indicate, with reasonable accuracy, location and magnitude of the work to be done and/or the character and quantity of the material to be furnished and the time and place of the opening of proposals.

Major and Minor Contract Items – Major contract items shall be the original Contract item of greatest cost, computed from the original Contract price and estimated quantity or lump sum price and such other Contract items next in sequence of lower cost, computed in like manner, necessary to show a total cost at original prices and quantities of not less than 60 percent of the original Contract cost, and all other Contract items shall be considered as minor items.

Median – The portion of a divided highway separating the traveled ways for traffic in opposite directions.

Minor Structure – Any structure not classed as a bridge or a culvert. It shall include catch basins, inlets, manholes, retaining walls, steps, fences and other miscellaneous items.

Non-Permanent Structure – A structure whose condition and location is affected more readily by severe weather conditions, home repairs, renovations, accidents, etc.

Permanent Structure – A structure which is not expected to change in location vertically or horizontally.

Plans – The official drawings issued by the Administration as part of the Contract Documents, including those incorporated in the Contract Documents by reference. These include the official approved plans, profiles, typical cross sections, working drawings and supplemental drawings or exact reproduction thereof which show the location, character, dimensions and details of the work to be done and which are to be considered as a part of the contract supplementary to these Specifications and which are identified as such.

Right-of-Way – The area which has been acquired and reserved by the Administration for the use in constructing the proposed improvement and appurtenances thereto.

Special Provisions – Special directions, provisions or requirements peculiar to the project and not otherwise thoroughly or satisfactorily detailed or set forth herein.

Specifications – The general term comprising all directions, provisions, and requirements contained herein, together with such as may be added or adopted as Supplemental Specifications.

Structures – Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other features which may be encountered in the work and not otherwise classed herein.

Subbase – The layer or layers of specified selected material of designed thickness placed on a subgrade to support a base course.

Subgrade – The material in excavation (cuts) and embankments (fills) immediately below any subbase, base, pavement, shoulder or other improved course.

Substructure – All of that part of the structure below bottoms of bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls and wingwalls.

Superstructure - All of that part of the structure above bottoms of bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, except as noted above for Substructure.

Supplemental Specifications – Additions and revisions to the Standard Specifications. Generally include new or improved procedures, construction items or materials developed subsequent to the publication of Standard Specification. Supplemental Specifications will prevail over those published in this book whenever in conflict therewith except the General Provisions.

Trench – An excavation made for the purpose of installing or removing pipes, drains, catch basins, etc. and which is later refilled.

Water Valve Tie Drawings – As-built drawings, which are produced in accordance with the City of Frederick Standard Details W-30 through W-30e series. A drawing which ties down the location of City maintained water valves by use of at least two dimensions from each water valve to two different permanent structures and which reflects only as-built conditions.

Working Day – A calendar day upon which, in the opinion of the Engineer, weather and soil conditions are such that the Contractor can advantageously work more than half of his current normal force for more than five consecutive hours on a major contract item or a controlling operation. Working days will not be charged on Saturdays, Sundays and State recognized holidays unless the Contractor actually works more than five hours on a major item or a controlling operation.

Working Drawings – Stress sheets, shop drawings, fabrication details, erection plans, plans for false work, forms, centering, and masonry layouts, bending and placing drawings and bar schedules for reinforcing steel and any other supplementary plans or similar data which the Contractor may be required to furnish.

SECTION 01102-

SITE CONDITIONS, IMPROVEMENT PLANS AND SPECIAL PROVISIONS

1. Shop Drawings and Working Drawings

The approved plans will be supplemented by such working drawings as are necessary to adequately control the work. It is mutually agreed that all authorized alterations affecting the requirements and information given on the approved plans shall be in writing and approved by the City. When at any time reference is made to the plans, the interpretation shall be the plans as affected by all authorized alterations then in effect. All plans shall be provided as 24" X 36" PDF and at a scale no larger than 1"=50', exceptions aloud for key maps, drainage areas and overall plans which are aloud up to 1"=100'.

The Contractor, Developer or Consultant shall provide, at his expense, all necessary and required working drawings and shall have them adequately checked, after which they shall be submitted to the City Engineer for review. The City Engineer may reject or disapprove such drawings and return for revisions in which case the Contractor, Developer or Consultant shall submit new additional or revised drawings as required. No items involving such drawings shall be incorporated in the work until those drawings have been accepted for the use by the City Engineer, but such acceptance shall not relieve the Contractor, Developer or Consultant of any responsibility in connection therewith. All working drawings shall be furnished for preliminary examination for projects prepared by the City by consultant engineering firms for the City. After drawings have been accepted for use by the City Engineer, the Contractor, Developer or Consultant shall furnish additional copies and digital files as requested. At the completion of contract, the general contractor and/or developer and/or consultant shall submit, at no cost to the City, one set of as-built drawings in digital format of specified as-built drawings.

All working drawings and submittals shall have identification data indicating the following information in order named:

- Project Name
- Location
- CIP Number (if applicable)
- Developer Name & Address
- Consultant Name & Address
- Sheet Title
- Date
- Sheet Number
- City File No. _____ (bottom right hand corner, to be provided by city upon first submission)

2. Digital Files

The Contractor, Developer or Consultant shall submit digital files of approved for construction drawings in PDF as required by the Engineering Department prior to approval. Digital files will also be required for revisions to previously approved plans as well as as-built drawings.

The following types of drawings with each submission are required in digital format:

1. **IP Approval- Entire set of Improvement Plans, SWM or SEC plans**
2. **Revisions to previously approved plans- revised cover sheet and all sheets affected by revisions**
3. **As-built drawings- revised cover sheet and all plan sheets that have been surveyed, with as-built information depicted by the color RED**

Digital File Specifications:

1. **Digital files shall be submitted to engineeringreview@cityoffrederickmd.gov up to 10 MB. Any files that are larger may be sent via a shared link or broken down and sent in several emails. No disks will be accepted, thumb drives acceptable upon request.**
2. **Subject line of email should clearly state type of project, project name and city file number assigned to project by engineering dept., emails will be returned if identification is not clear. Sample shown below:**
 - **Improvement Plan – Project Name PZ-xx-xxxx**
 - **Cost Estimate – Project Name PZ-xx-xxxx**
 - **As-Built Plans – Project Name PZ-xx-xxx**
3. **The City Engineering Department reserves the right to reject any digital file submitted which is not compatible with the City's listed requirements for submittal. The Contractor, Developer or Consultant would then be required to resubmit the files in an acceptable format.**

3. As-Built Drawings

Prior to final project acceptance and the release of the guarantee, the contractor, developer or consultant shall provide the City with, one complete set of digital format files of the as-built drawings showing all public improvements and other selected project improvements, as actually constructed in the field. As-built drawings shall be submitted to the Director Engineering for acceptance*.

*See Section 01102, No. 2 Shop Drawings and Working Drawings for minimum/maximum acceptable sheet sizes and Section 01102, No.3 Digital Files for digital file requirements.

Drawings shall be prepared using field run measurements and elevations to show the horizontal and/or vertical location of the project improvements after the completion of their installation or construction and shall be certified to by a Maryland Registered Land Surveyor.

All as-built information shall be designated in RED in the finalized pdf. As built information is to be clearly distinguishable on all digital files.

Drawings shall reflect the following accuracy specifications:

- a. Stormwater management ponds shall be in accordance with the standards and specifications set by the area Natural Resources Conservation Service office for as-built drawings. Field run measurements and elevations shall be certified by a Maryland Registered Land Surveyor. A Maryland Registered Professional Engineer shall certify all stormwater management as-builts to guarantee that the stormwater management facility operates as designed.
- b. Horizontal and vertical as-built field and design information on plan and profile drawings shall be provided for but not limited to:
 1. Elevations, stationing, distances and measurements to be expressed to the nearest hundredth.
 2. Public utilities and utility structures for sanitary sewer, storm drain, water and electrical: pipe classes, pipe types and sizes, pipe slope percentages; top of manhole, inlet and other structure elevations; pipe invert elevations in and out, pipe elevations crossing the path of public utilities, etc.
 3. Public road, streets, alleys, drives, etc: Finished centerline profile grade elevations; horizontal and vertical curve data; street centerline intersection elevations; Finished grade slope percentages, etc.
 4. Public sidewalks, paths, trails, buildings, park layouts, etc.
 5. Contours: extend 50' on each side of City street rights-of-way, extend 25' on each side of City easements, within the boundary of City owned lands, etc.

6. **Horizontal as-built information is required for the following private facilities; buildings, structures, streets, roads, alleys, drives, parking lots, etc.**
7. **Horizontal and vertical as-built information is required for the following private facilities which cross or tie into public utilities or which affect or may affect a public facility including pipe inverts in and out, pipe sizes, pipe elevations and location where private lines cross public utilities, streets, rights-of-way and easements.**

As-built submittals shall include all plans, profiles, details, notes, schedules and other pertinent sheets. The cover sheet of the project shall be included with the as-built submittal. The cover sheet shall include all required as-built certifications and shall clearly show which drawings are as-built. All as-built drawings shall have the "AS-BUILT" label clearly and prominently shown on each submitted drawing, preferably in the lower right hand corner of the drawing.

The as-built drawings shall include on all as-built sheets the following certification signed and dated by the appropriate Maryland Registered Professional Engineer and/or Maryland registered Land Surveyor assuming responsibility for the submitted project. The Maryland Registration number of the signing professional shall be designated.

All as-built drawings shall include, on all as-built sheets, the following certification signed and dated by the appropriate Maryland Registered Professional Engineer and/or Maryland Registered Land Surveyor assuming responsibility for the submitted project:

"I hereby certify that to the best of my professional knowledge, information and belief, this complete set of drawings submitted is as-built. The improvements have been filed located and meet the requirements set forth in the City of Frederick Standard Construction Specifications Section-01102 entitled "Site Conditions, Plans and Special Provisions" Subsection 3 entitled "As-Built Drawings".

_____ Date: _____
 Engineer/Surveyor Signature, Title and
 Maryland Registration Number

All field as-built measurements and elevations shall be certified to by a Maryland Registered Land Surveyor. A Maryland Registered Professional Engineer shall certify all stormwater management and design as-builts to ensure the facilities operate as designed.

The City Engineer reserves the right, as the approving authority, to reject any set of drawings and digital files, in whole or in part, which does not reflect in full the above as-built criteria.

4. As-Built Water Valve Tie Drawings

Prior to final project acceptance and the release of the guarantee, the contractor, developer or consultant shall provide the City with all water valve tie drawings in pdf format.

Water valve tie drawings shall be produced in accordance with the criteria set forth in the City of Frederick Standard Details (see Detail Sheet W-30A- B) and certified to by a Maryland Registered Land Surveyor. The criteria set forth for the drafting of water valve tie drawings ensure that they will appear uniform even though produced by different consultants.

5. As-built Criteria for Parkland Acceptance

The following criteria must be met prior to acceptance of parkland:

- a) All pertinent adjacent improvements must be installed (curb, public walk, paving, streetlights, homeowner's association items, etc.)
- b) All property corners must be in place.
- c) Grading complete in accordance with approved plans and City Specifications. This includes removal of all sediment control devices.
- d) Site must be "green" (i.e. permanent seeding in accordance with Frederick Natural Resources Conservation Service stabilization specifications).
- e) As-built drawings must be approved.
- f) Submit deed recordation documents for review and approval.
- g) Remove any undesired vegetation, trees, etc. as directed in the field.

6. Specifications

These Specifications, the Supplemental Specifications, the Plans, Special Provisions and all supplementary documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete project. In the event of any discrepancy between the drawing and figures written thereon, the figures, unless obviously incorrect, will govern over scaled dimensions. In the case of any discrepancy between the Plans and Specifications, the Supplemental Specifications will govern. Special Provisions will govern over Specifications, Supplemental Specifications and Plans. General Provisions will govern over all Contract Documents unless expressly provided for in the contract.

7. Water and Sewerage Construction Permits

The developer/ contractor/ agent must comply with all terms and conditions of the associated Water and Sewerage Construction Permit issued by the Maryland Department of the Environment, Water Management Administration. A copy of the approved permit, which is issued to the City, will be forwarded to the developer/ contractor/ agent for compliance with all terms and conditions as listed in the permit. Upon completion of all work under the associated permit and upon City acceptance of the improvements and release of the surety, the Department of Permits and Code Management will complete the Water and Sewer Construction Completion Certificate and submit to the Maryland Department of the Environment as required by the Permit.

8. Stormwater Management Notice of Construction Completion Form

The developer/ contractor/ agent shall submit a completed Notice of Construction Completion Form to the City upon completion of construction of stormwater management devices/facilities.

Note:

Work Suspension

The City will have the authority to suspend the work, wholly or in part due to the failure of the Contractor to correct conditions unsafe for the workmen or the general public; for failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work; or for any other condition or reason deemed to be in the public interest.

SECTION 01103

MATERIAL SOURCES, SAMPLES AND TESTS

1. Approval of Material Sources

The Engineer will inform the Contractor as to the acceptability of each material source as soon as an evaluation of the sources proposed can be made. No material may be incorporated into the work until approval of the source has been given. Where delivery of materials to the job site is made prior to approval, such delivery is made at the Contractor's risk and subject to immediate removal at no cost to the City in cases where it is determined that the source is not acceptable.

Material sources may be rejected even though prior samples meet the applicable Specifications where it is evident that the material tends to be of marginal quality as compared to the Specification limits in one or more of its properties.

All source approvals are made subject to continuing production of material meeting the Specifications. Where this condition is not met, the approval of any source may be withdrawn by the Engineer at any time.

2. Approval of Plants and Shops

Immediately upon receipt of Notice of Award of the Contract, the Contractor shall submit in writing for the Engineer's approval the location and ownership of those plants or fabricating shops at which materials for the project will be processed.

The Engineer will inform the Contractor as to the acceptability of the proposed plants or shops as soon as an evaluation can be made. No material is to be shipped from these sources until this approval has been given.

Plant or shop approvals are made subject to continuing production of materials meeting the Specifications. Where this condition is not met, the approval of any plant or shop may be withdrawn by the Engineer at any time.

3. Samples, Tests, Cited Specifications

All materials used in the work will be inspected, sampled and tested in accordance with these requirements and such others as are set forth elsewhere in these Specifications or in the Special Provisions in which particular reference is made to a specific material. Unless otherwise designated, tests will be made in accordance with the most recently published cited standard, tentative or interim methods of AASHTO, ASTM or others which are current on the date of advertisement for Bids. These tests will be made by and at the expense of the City.

Acceptance testing by the City as described here and elsewhere is not to be considered as a replacement for control testing conducted by the Contractor or a manufacturer producing materials for the Contractor. When the Contractor or manufacturer is not providing adequate control testing facilities in his own behalf, the Engineer may refuse to carry out re-sampling and testing of materials which have been shown to be defective by normal sampling and testing routines, The Engineer may also refuse to resample and test defective materials until and unless corrective action has been taken by the Contractor or manufacturer.

4. Certification of Compliance

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

Materials or assemblies used on the basis of Certificates of Compliance 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.

The form and distribution of Certificates of Compliance will be as approved by the Engineer.

The Engineer reserves the right to refuse permission for use of materials or assemblies on the basis of Certificates of Compliance.

5. Project Control Testing

Materials from approved sources, plants or shops will be subjected to control tests by the Engineer at such locations with such frequency as he deems appropriate.

The point or points of sampling will be those points at which required physical or chemical properties are to be met. It is intended that insofar as is practical, these points will be the points in the productive process just prior to inclusion into the work or into combination with other materials. It is also intended that sampling and testing be conducted in such a manner and at such points as to minimize interference with the maintaining of an efficient schedule by the Contractor. Where the nature of the work precludes the attainment of both these ends simultaneously, the Engineer will designate the points of sampling in a manner so as to insure that the Specifications are met.

While it is required that all materials will conform to the specified values for all properties, the Engineer may designate different points of sampling and different sampling integrals for separate characteristics of any material.

The Contractor shall assist in the sampling of materials and make provision for safe and reasonable access.

The Engineer may elect where possible to sample and test lots of material at the point of manufacture. In this case, lots may be given approval and, where practical, so marked by the Engineer. This procedure assumes that consistent production and appropriate storage, handling and shipping practices shall be maintained by the manufacturer, the hauler and the Contractor. Such approval does not preclude subsequent inspection, sampling and testing of materials at the job site with acceptance or rejection being predicated on the results of these later procedures.

6. Handling of Materials

Materials shall be handled in such a manner as to preserve their quality and acceptability for the work. Handling equipment and hauling vehicles shall be so constructed as to prevent loss, contamination or segregation of materials during or after loading.

SECTION 01104

RESTRICTIONS AND PERMITS

1. Moving of Equipment

The Contractor will not be permitted to move over or operate on any road (except on the road under construction) any power shovels, rollers, concrete mixers, cranes, tractors or any other heavy equipment of weight or dimensions in excess of Maryland Motor Vehicle Law and/or State Highway Administration's regulations without first obtaining the usual permit.

2. Railroad Highway Grade Crossings and Separations

In case the Contractor is required to haul materials across the tracks of any railroad, or elects to do so, he shall make his own arrangements with that railroad for any new private crossing required or for the use of any existing private crossing.

All work to be performed by the Contractor in the construction of railroad-highway separation structures on the railroad right-of-way shall be done in a manner satisfactory to the Engineer of the railroad company and shall be performed at such times and in such a manner as not to unnecessarily interfere with the movement of trains or traffic upon the track of the railroad company. The Contractor shall use all care and precaution in order to avoid accidents, damage or unnecessary delay or interference with the railroad company's trains or other property. The Contractor will further be required to carry such public liability and property damage insurance as may be stipulated elsewhere in these Specifications or in the Special Provisions.

All work on portions of structures over railroad right-of-way shall conform to all rules and regulations of the owners of the right-of-way. The Contractor is hereby made responsible for acquiring full knowledge of these rules and regulations and complying therewith to the satisfaction of the owners of the railroad right-of-way.

Prospective bidders on contracts crossing railroad right-of-way are advised that the railroad company will require the Contractor to obtain, pay for and have approved by the railroad, certain broad forms of public liability and property damage insurance policies before entering upon the railroad property. As a general rule, details of such policies are set forth in the Special Provisions, the Contractor is hereby required to communicate with the railroad so as to ascertain the type of insurance required, if any, and make provisions for same in the Bid.

The proceeding sentence would particularly apply in the even the Contractor desired to establish a temporary crossing of the railroad property for his own convenience and operation. In this case, the Administration would have no knowledge of such crossing and, therefore, could make no mention in the Special Provisions. Unless otherwise provided in the Proposal, costs of insurance

policies, whether described in the Special Provisions or ascertained by the Contractor, will not be set up in any special item; and the cost, therefore, must be included in and distributed over items which are set forth.

3. Work in or Over Waters of the State

All work in, on or over waters under control of the Department of the Army and/or the Environment Protection Agency of the United States shall conform to all applicable Federal rules and regulations. All such rules and regulations are hereby part of the Contract. The Contractor is cautioned and charged with the responsibility of obtaining complete knowledge thereof and compliance therewith. The Contractor shall also comply with the provisions of other applicable Federal, State and Local Laws and is cautioned to acquaint himself with any pertinent regulation of the Department of Natural Resources, Water Resources Administration.

4. Use of Explosives

The use of explosives will not be permitted adjacent to or on any existing structures unless authorized in writing by the Engineer. When the use of explosives is permitted, the Contractor shall use the utmost care so as not to endanger life or property; and whenever necessary the number of charges and size of the charge shall be reduced. The Contractor's attention is directed to the necessity of safeguarding and traveling public during dynamiting operations and a sufficient number of watchpersons, flaggers, signs, etc. shall be used to warn motorists during the periods of blasting. All explosives shall be stored in a secure manner, and all such storage places shall be marked clearly "Dangerous Explosives" and shall be in care of competent watchpersons at all times. Explosives shall be stored and handled in conformity with the provisions of the statutes of the State of Maryland and local laws and ordinances.

The Contractor shall notify each public utility company having structures in proximity to the site of the work of his intention to take such steps as they may deem necessary to protect their property from injury. Such notice shall not relieve the Contractor of responsibility for any damage resulting from his blasting operations.

5. Cultural Resources

The Contractor should be aware of the potential of cultural resources. During the construction phase, whenever anything that might appear to be a cultural resource of any historical, archeological or paleontological nature is encountered, such an object shall not be disturbed. Work shall be stopped and rescheduled in such a way as to avoid not only the objects but also the area of discovery and the Engineer notified at once. The engineer will arrange for the evaluation of the situation by the appropriate authorities and for the ultimate disposition of the matter, taking the evaluation of the situation by the appropriate authorities into consideration.

6. Insurance

Prior to the commencement of work, the Contractor shall submit to the Engineer a Certificate of Insurance indicating that he carries comprehensive general public liability and property damage insurance in the amounts as specified in the Contract Special Provisions.

7. Subcontracting

The Subcontractors who are named in the Proposal Form and approved by the City, and those approved when subsequently submitted, shall perform the Contract items as approved by the City. Requests for permission to sublet, assign or otherwise dispose of any portion of the Contract shall be in writing and include the item number or numbers and the dollar value. Each request for permission to sublet, assign or otherwise dispose of any portion of the Contract must be accompanied by written consent from the Contractor's surety. The contractor shall give assurance that the minimum wage for labor, as stated in his Proposal, shall apply to labor performed on all work sublet, assigned or otherwise disposed of in any way.

The City will not approve subletting portions of items except in the case of specialty items such as the erection of structural steel, painting or such portions of items which are distinct and identifiable and which have been approved by the Engineer.

Once a subcontractor has been approved by the City and surety for the performance of certain Contract items of work on the subject Contract, the City will not allow the Contractor to substitute another Subcontractor, except in the event the Contractor request in writing that the approved Subcontractor be relieved of the necessity of performance of said work. Any such change of subcontractors must be requested in writing by the principal Contractor and must have the written concurrence of the previously designated Subcontractor. Such concurrence shall not be unreasonably delayed in the judgment of the City in the event that a Subcontractor does not perform to the satisfaction of the prime Contractor, the prime Contractor may perform the work with his own forces or request that another Subcontractor, mentioned by name, be substituted. When reasons submitted for the substitution of the Subcontractor indicate that the change will be in the best interest of the City, approval of the request will be granted.

Roadside production of materials unless performed by the Contractor shall be considered as subcontracting. This is constructed to mean the production of crushed stone, gravel and/or other materials by means of portable or semi portable crushing, screening or washing plants, established or reopening in the vicinity of the work for the purpose of supplying materials to be incorporated into the work on a designated project or projects.

The purchase of sand, gravel, crushed stone, crushed slag, batched concrete aggregates, ready mix concrete and/or other materials produced at furnished from established and recognized commercial hauling companies, shall not be considered a subcontracting.

8. Notice to Proceed

No work is to be started before receipt of the Notice to Proceed.

9. Material Storage

If it should become necessary to stop work for an indefinite period, the Contractor shall store all materials in such a manner that they will not obstruct or impede the traveling public unnecessarily nor become damaged in any way; and he shall take every precaution to prevent damage or deterioration of the work performed, provide suitable drainage by opening ditches, shoulder drain, etc. and erect temporary structures where necessary.

10. Determination and Extension of Contract Time

The Contractor shall complete the work contracted for in an acceptable manner within the number of working days or calendar days as stated in the Contract.

The number of days allowed for the completion of the work included in the Contract will be fixed by the City and stated in the Proposal and Contract and will be known as the Contract Time.

The Engineer will make available to the Contractor each week a record showing the number of days specified for completion of the Contract. The Contractor will be allowed one week in which to protest and 30 days in which to file a written statement, setting forth in what respects said time charges are incorrect, otherwise the record will be deemed to have been accepted by the Contractor as correct under hereinbefore stated definition of working days.

The number of days for performance allowed in the Contract as awarded is based on the proposal quantities. If satisfactory fulfillment of the Contract, with extension and increases authorized under Sections on Variations in Estimated Quantities and Changes as outlined in the General Provisions and Supplemental Agreements shall require the performance of work in greater quantities than those set forth in the Proposal, the Contract time allowed for performance shall be adjusted in an equitable manner based on the quantities, costs and the nature of the work involved.

The Contractor, under certain conditions, may be granted permission or ordered to suspend operations as authorized under Section on Suspension of Work as outlined in the General Provisions. During such periods, if the Contractor elects and is permitted to do any work, the time charged shall bear the same ratio to the total time allowed for the completion of the work, as the value of the work done

during such time bears to the total value of the Contract. However, the resultant number of days to be charged for any particular month will never exceed the number of calendar days for that month, excluding Saturdays, Sundays or official holidays on which no work was performed by the Contractor on a controlling item.

Time used in performing work of an emergency nature ordered by the public or for the production or delivery of materials for storage, if performed during the period of suspension, will not be charged as working days against the Contract Time.

Following the date on which all work has been completed, except those landscaping items on which work is restricted to specified seasons and when final inspection and acceptance is being deferred pending completion of those landscaping items on which work is not permissible at the time because such work is currently out of season, and for no other reason, no time will be charged against the Contractor until such time as it is again permissible to proceed with such work. However, time will be charged during any extensions of the specified season, which may be granted the Contractor.

11. Measurement of Quantities

For all items of work, other than those to be paid by lump sum, after the work is completed and before final payment is made therefore, the Engineer will make final measurements to determine the quantities of various items of work performed as the basis for final settlement. The Contractor in case of unit price items will be paid for the actual amount of work performed and for the actual amount of materials in place, in accordance with the Specifications as shown by the final measurements. All work completed under the Contract will be measured by the Engineer according to the standards of weights and measures recognized by the National Bureau of Standards.

All longitudinal measurements for area will be made along the actual surface and not horizontally and no deductions will be made for individual fixtures in the pavement having an area of square feet or less. For all transverse measurements for area of base course and pavements, the dimensions to be used in calculating the pay area will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown in the plans or as ordered in writing, unless otherwise provided for elsewhere in the Specifications or in the Special Provisions.

Volumes of excavation, tamped fill and borrow pits will be calculated from the cross section and the use of average end area formulas. Volumes of other work such as masonry, removal of masonry, etc. will be calculated by using arithmetical formulas. Where the volume is bounded by varying dimensions and there are no simple volumetric formulas applicable, frequent cross sections will be taken and the volume computed from the average end area formulas.

Cement will be measured by weight in hundredweight (cwt) units.

All items which are measured by the linear foot, such as pipe culverts, guardrail, under drains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the plans.

The term “gage”, when used in connection with the measurement of uncoated steel sheet and light plates shall mean the U.S. Standard Gage, except that when reference is made to the measurements of galvanized or aluminum sheets used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing the term gage shall mean that specified in AASHTO M-36, M-167, M-196 or M-197.

When the term gage refers to the measurement of wire, it shall mean the wire gage specified in AASHTO M-32.

The term “ton” shall mean the short ton consisting of 2000 pounds avoirdupois. All materials, which are specified for measurement by the ton shall be weighed on accurate, approved scales. If material is shipped by rail, the care weight may be accepted provided the actual weight of the material only will be paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the Engineer directs and each truck shall bear a plainly legible identification mark.

All materials for which measurements are obtained by the cubic yard, loose measurement or measured in the vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. No allowance will be made for the settlement of material in transit. Approved vehicles for this purpose shall be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. Unless all approved vehicles are of uniform capacity, each approved vehicle must bear a plainly legible identification mark indicating the specific approved capacity. All vehicles shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.

When requested by the Contractor, and approved by the Engineer in writing, material specified to be measured by the cubic yard may be weighed, and such weights will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the laboratory and shall be agreed to by the Contractor before such method of measurement of pay quantities will be approved by the Engineer.

Bituminous material will be measured by volume in the railroad tank car, tank truck, distributor tank, or drums in which it is delivered. Each railroad tank, tank truck, drum or distributor tank of bituminous material delivered for the project will be measured. The measurements will be taken when the bituminous material is of a uniform temperature and free from air bubbles, and the temperature of the material will be recorded.

The volumetric measurement of the bituminous material for these Specifications will be based upon temperature of 60 °F.

Reference is made to ASTM D-1250 Petroleum Measurement Tables and ASTM D-633 Volume Correction Table for Tars.

Only the quantity of bituminous material actually placed in the work and accepted will be considered in determining the amount due the Contractor.

Timber will be measured by the thousand feet board measure (MBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term lump sum, when used as an item of payment, will mean complete payment for the unit of work described.

When complete structure or structural unit (in effect, lump sum work) is specified as the unit measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by time in hours of actual working time, moving in and moving out costs, if any, and necessary traveling time of the equipment within the limits of the project except when special conditions make some other method of measurement desirable.

12. Payment Allowance

When the Contractor requests payment allowance for materials in accordance with the section on Scope of Payment as outlined in the General Provisions, the following terms and conditions will apply:

For superstructure members delivered on the project site, an allowance of 100 percent of the material cost plus freight charges as invoiced may be made. The allowance will be based upon validated invoices or bills for such material including freight charges, and a copy thereof shall be made a part of the documented records for the project.

For reinforcing steel, piling, pipe, guardrail, signs and sign assemblies, and other nonperishable material in storage on the project but excluding aggregates, cement, seed plants, fertilizer or other perishable items and allowance of 100 percent of the invoiced cost of the material plus freight charges to the Contractor may be made when such material is delivered and stockpiled at the project site provided, however, that all such material will have been tested by the City and found to have met the Specifications or have been accepted under any approved certification program prior to such an allowance.

No allowance will be made for fuels, form lumber, false work, temporary structures or other materials of any kind, which will not become an integral part of the finished construction.

All material for which an allowance is requested shall be stored in an approved manner in areas where damage is not likely to occur.

If any of the stored materials are lost or become damaged in any manner, the Contractor shall be responsible for repairing or replacement of such damaged materials. The value of the lost or damaged material will be deducted from the Contractor's subsequent estimates until replacement has been accomplished. The request for allowances for any materials stored on private property shall be accompanied by a release from the owner and/or tenant of such property agreeing to permit the removal of the materials from the property without cost to the City.

When it is considered impractical to store materials on the actual project, the Engineer may approve storage areas in the vicinity of the actual project which will be considered at the project site.

Material for which payment has been made, either wholly or partially, shall not be removed from the approved location until such time that it is to be incorporated into the work, unless authorized by the Engineer.

The following prerequisites must accompany the written request for payment:

- * Consent of surety specifying the material type and the item(s) in which the material is to be used;
- * Validated invoices showing that payment for the material has been made;
- * A notarized statement from the Contractor attesting that the invoices, as submitted, do not include charges and/or fees for placing, handling, erecting or any other charges and/or markups other than the actual material cost, sales tax(es) if applicable, and freight charges;
- * Bills of lading showing delivery of the material;
- * Inspection test reports, certifications and/or a written statement from the inspector attesting to the inspection and approval of the material.

Upon receipt of the above by the Engineer and verification by the inspector that the material is stored at the approved location, the Engineer will authorize payment by a unit of measure based upon the receipted invoices under the appropriate existing items of the Contract. A ratio will be established by the inspector between the dollar amount of the material as invoiced and the quantity the material represents from the appropriate proposal items.

Copies of all pertinent data shall be made and distributed to the inspector for retention as part of the documented records for the project.

No payment for stored material will be made if it is anticipated that the material will be incorporated into the work within 30 days of the written request.

13. Labor Rates on Force Account Work

The Engineer and the Contractor shall agree on the labor rates before any force account work is begun.

The Contractor shall receive the current rental rates recommended in the Rental Rate Blue Book for Construction Equipment for the use of any machinery or special equipment authorized by the Engineer. The rental rates must be agreed upon in writing before work is begun, except in those cases where the Engineer finds that an emergency exists. Payment will be made for the actual number of hours the equipment is required at the work site. The maximum number of hours allowed for each working day will be eight or the actual number of hours in operation, whichever is greater. The rate to be paid per hour will be computed by dividing the weekly rate by 40 or the monthly by 176. Weekly rates will be the basis for computation of hourly rates when equipment use does not exceed a total of three weeks in time, and monthly rate will be the basis for computation of hourly rates when equipment use exceeds a total of three weeks in time. Monthly rates will be used for all equipment that was used on the project before the force account work is begun and/or remains on the project for use afterward if the total time on the project exceeds three weeks.

Approved transportation charges will be paid from and to the nearest source if the equipment is brought to the project specifically for use on the force account work and is not used on any other work.

The rental rate will consist of the sum of the following:

- a) The rate for the basic piece of equipment;
- b) The rate for attachments (where applicable); and
- c) The estimated hourly operating cost (where applicable).

These component parts of the rate are to be obtained from the Rental Rate Blue Book when listed in that book. If a piece of equipment is not listed in the Rental Blue Book, then the rate will be the prevailing rate being paid in the area where the force account work is being performed.

When equipment is used in excess of eight hours per day or 40 hours per week, the excess time will be considered as overtime. The rental rates for this overtime will be the sum of 50 percent of a), 50 percent of b) and 100 percent of c) above.

Whenever equipment is ordered by the Engineer to be held on the project on a standby basis, or when the Administration is obligated for other reasons to pay for idle equipment, then the rate will be 75 percent of the rental rate with no allowance for operating costs. Standby or idle time cannot exceed eight hours per day and will not be allowed for Saturday and Sunday. Non-operating time for equipment required for force account work is not considered standby or idle time if the equipment is operated and used at least once during each working day.

Regional Rate Modifications and Life Expectancy Adjustment will not be allowed.

14. Eliminated Items

Should any Contract items contained in the Proposal be found unnecessary for the proper completion of the work contracted, the Engineer may, upon written order to the Contractor, eliminate such Contract items from the Contract under the terms and conditions described under section on Variations in Estimated Quantities as given in the General Provisions. Such action will in no way invalidate the Contract, and no allowance will be made for items so eliminated in making final payment to the Contractor except as stipulated in said section on Variations in Estimated Quantities as given in the General Provisions and/or for such work as may have been done, materials actually delivered and bonafide equipment costs prior to notification of the elimination of the items.

DIVISION 2

SITE WORK

| <u>SECTION NUMBER</u> | <u>TITLE</u> | <u>SHEET</u> |
|-----------------------|--|---------------------|
| 02040 | MAINTENANCE OF TRAFFIC | 02040-1 To 02040-2 |
| 02060 | DEMOLITION: REMOVAL AND DISPOSAL OF EXISTING BUILDINGS | 02060-1 To 02060-2 |
| 02070 | BLASTING | 02070-1 |
| 02100 | CLEARING AND GRUBBING | 02100-1 To 02100-3 |
| 02101 | EROSION AND SEDIMENT CONTROL MEASURES | 02101-1 To 02101-3 |
| 02130 | CONSTRUCTION STAKEOUT | 02130-1 To 02130-3 |
| 02200 | EARTHWORK | 02200-1 To 02200-13 |
| 02270 | SLOPE AND CHANNEL PROTECTION | 02270-1 To 02270-9 |
| 02301 | BORED AND/OR JACKED PIPE | 02301-1 To 02301-4 |
| 02302 | EARTH TUNNELING | 02302-1 To 02302-9 |
| 02303 | ROCK TUNNELING | 02303-1 To 02303-10 |
| 02320 | CONCRETE LINING | 02320-1 To 02320-5 |
| 02321 | SHOTCRETE | 02321-1 To 02321-7 |
| 02330 | DRILLING AND GROUTING | 02330-1 To 02330-6 |
| 02340 | ROCK REINFORCEMENT AND SUPPORT | 02340-1 To 02340-7 |
| 02500 | ROADWAY PAVEMENT | 02500-1 To 02500-5 |
| 02515 | BRICK SIDEWALK | 02515-1 |

DIVISION 2 (Continued)

SITE WORK (Continued)

| <u>SECTION NUMBER</u> | <u>TITLE</u> | <u>SHEET</u> |
|-----------------------|---|---------------------|
| 02525 | CURB, CURB AND GUTTER AND SIDEWALK | 02525-1 To 02525-3 |
| 02575 | REMOVAL OF PAVING MATERIAL BY MILLING | 02575-1 To 02575-2 |
| 02660 | WATER SYSTEM | 02660-1 To 02660-23 |
| 02661 | CHLORINATION OF WATER SYSTEM | 02661-1 To 02661-2 |
| 02700 | STORM DRAIN AND SANITARY SEWER SYSTEMS | 02700-1 To 02700-20 |
| 02770 | STORMWATER MANAGEMENT PRACTICES | 02770-1 To 02770-6 |
| 02830 | CHAIN LINK FENCE | 02830-1 To 02830-6 |
| 02930 | SEEDING AND SODDING | 02930-1 To 02930-10 |
| 02950 | LANDSCAPING | 02950-1 To 02950-10 |

SECTION 02040

MAINTENANCE OF TRAFFIC

1. General

A. Description

This work pertains to the maintenance of traffic, both vehicular and pedestrian, on any facility affected by the work of the Contract.

B. Execution

All work shall be in accordance with the latest issue of the Manual on Uniform Traffic Control Devices (MUTCD), Specifications, Plans, Special Provisions, and as directed by the Engineer. Unless specifically set up in the Proposal as a Contract pay item, it shall include furnishing traffic managers and flaggers, relocating, maintaining, and removing existing traffic signs and other traffic devices, and implementation of a Traffic Control Plan (TCP).

2. Materials

All materials used, whether temporary or permanent, shall meet the requirements of the Specifications, Plans, Standards, and Special Provisions.

3. Construction Requirements

The Contractor shall provide for the safe and expeditious movement of all traffic through the project in accordance with the TCP, Plans, Special provisions, and as directed by the Engineer.

Equipment which is in use and requires temporary storage within the limits of the project and materials stored or stockpiled on the project shall be placed in a location which shall not be hazardous to traveling public and as approved by the Engineer.

4. Method of Measurement

Maintenance of Traffic will not be measured but will be paid for a lump sum basis. If additional Contract pay items for Maintenance of Traffic are provided for in the Proposal, the method of measurement will be in accordance with the pertinent specification.

5. Basis of Payment

All work incident to maintenance of traffic, inclusive of traffic managers and flaggers; the relocating, maintaining, and removal of existing traffic signs and other traffic devices; implementation of a Traffic Control Plan will be paid for at the Contract lump sum price for Maintenance of Traffic. This price shall include all materials, tools, labor and work of any kind to this item, except when otherwise specifically set up in the Proposal as a Contract pay item.

If additional items for Maintenance of Traffic are included in the Contract, the basis of payment will be in accordance with the pertinent specification.

The material necessary in the construction of temporary or detour roads, the surfacing of temporary roadways, turnouts, etc., will not be included in the item Maintenance of Traffic, but will be paid for at the respective unit price for excavation and the furnishing and placing of such materials as may be necessary for the construction of such temporary roads. Surfacing and removal of detour roads as shown on the Plans or called for in Special Provisions will be measured and paid for at the unit price for Class 1 Excavation.

When specified, temporary bridges shall be incidental to the Maintenance of Traffic item; costs of all materials, lumber, piling, hardware, painting, erection, driving piles, carpentry, as well as removal of temporary bridges shall be included in the Contract lump sum price bid.

SECTION 02060

DEMOLITION: REMOVAL AND DISPOSAL OF EXISTING BUILDINGS

1. General

A. Description

This work provides for the removal and disposal of buildings and the protection thereof until the removal and disposal are accomplished.

2. Materials

Not Applicable.

3. Construction Requirements

Buildings and appurtenances designated for removal shall not be disturbed by the Contractor until he has received his Notice to Proceed. As soon as the notice and approval of the Engineer have been received, the Contractor shall schedule these buildings for removal, razing or occupation as one of his first items of work.

Any building used by the Contractor for purposes such as field office, storage, etc. may remain as an exception of the above but shall be immediately disposed of when vacated.

Buildings and appurtenances designated for removal shall not be disposed of by burning if they are located in close proximity to habitable dwellings, or if local or State laws, regulations, ordinances, etc., prohibit burning.

Salvaged materials shall become the property of the Contractor, and the materials when sold by the Contractor shall be removed by the purchaser only during daylight hours, Monday through Saturday, and in company with an authorized Contractor representative.

It shall be the Contractor's responsibility for posting and protecting the buildings from vandalism or theft until they are removed in order that the properties will not become a blight to the surrounding neighborhood.

The Contractor shall notify the owner of all utilities to affected buildings to shut off or abandon utility service.

The locations of the buildings included in the item will be designated on the Plans by the numbers 1,2,3, etc.

4. Method of Measurement

This item will not be measured for payment. The City, however, reserves the right to eliminate from this item any or all buildings or structures. These buildings or structures may be removed off the site of the work by others or reserved for the property owners.

For each and every building eliminated from this item, the item will be credited to the extent of the cost eliminated, which will be determined from a breakdown to be submitted by the Contractor, showing the tabulation of individual unit costs used in arriving at the Contract price for this item. A breakdown of the Contract lump sum price for Removal and Disposal of Existing Building shall be submitted to the Engineer prior to commencement of work. Contractor to notify owner of all utilities to shut off or abandon.

5. Basis of Payment

Removal and Disposal of Existing Buildings will be paid for at the lump sum price bid minus the listed price for each unit not removed by the Contractor.

SECTION 02070

BLASTING

1. General

A. Description

This section pertains to blasting done for the construction of miscellaneous site work, utilities and roadways to be built within the City of Frederick.

2. Requirements

The use, storage and transportation of explosive materials relating to this work shall conform to the N.F.P.A. Code No. 495.

3. Blasting for Utilities

Blasting beyond the limits of utility lines will be required for a minimum of 10' (ten feet) beyond the end of said lines. Along the same alignment and grade or as directed.

No blasting will be permitted within 10' (ten feet) of any existing utility lines without the permission of the owner of said utility.

SECTION 02100

CLEARING AND GRUBBING

1. General

A. Description

This section includes clearing and grubbing of all areas within the Contract limits of right-of-way and other areas indicated, including work designated in permits and other agreements, in accordance with the Contract Documents.

B. Definitions

Clearing is the removal, within the designated areas, of trees, brush, shrubs, down timber, decayed wood, other vegetation, and rubbish, as well as the removal of fences and incidental structures. Grubbing is removing from the ground all stumps, roots, stubs, brush, organic materials and debris.

2. Execution

A. Disposition of Trees in Private Property

Trees and shrubs, within the limits of the right-of-way, shall be removed unless otherwise indicated in the Contract Documents. Do not cut or damage trees outside the right-of-way unless so indicated or unless written permission has been obtained from the affected property owner. Three copies of such permission shall be furnished to the Engineer before removal operations commence. Submit requests by property owners to stockpile cut logs to the appropriate City officials.

Remove trees and shrubs in such a manner as to avoid damage to trees and shrubs designated to remain. Trees felled outside of the immediate trench excavation or other excavation area shall have their stumps cut to ground level unless directed otherwise by the Engineer. Trees felled within the immediate vicinity of the trench or other excavation shall have their stumps removed and disposed of in authorized permitted disposal site.

Protect all other trees and shrubs from defacement, injury, and destruction. Preserve trees within the right-of-way or construction strip that are so delineated on the Plans or are marked in the field by red paint.

Do not cut roots unnecessarily; handwork or otherwise prevent damage to roots which extend into grading limits or limits of excavation. Disturb roots as little as possible when tunneling under trees. Backfilling around tree roots shall be done immediately after completion of construction in the vicinity of trees.

The Contractor shall be responsible for the protection of all vegetation from damage resulting from emissions from motorized equipment.

During working operation, protect the trunk, foilage, and root system of all trees to be saved with boards or other guards placed as shown and as required to present damage, injury, and/or defacement. Do not pile excavated material adjacent to the base of any trees. Do not allow runoff to accumulate around base of trees. Do not fasten or attach ropes, cable, or guy wires to trees without permission of the Engineer. When such permission is granted, protect the tree before making fastening or attachments by providing burlap wrapping and softwood cleats. The Contractor shall be held responsible for damage resulting from these actions. Use of axes or climbing spurs for trimming will not be permitted. Provide climbing ropes during trimming.

Remove shrubs to be saved, taking a sufficient earth ball at the roots to maintain the shrub. Temporarily replant if required, and replace at the completion of construction in condition equaling the original.

Tree and shrub repair, where required, shall be performed by a tree surgeon properly licensed by the State of Maryland.

B. Disposition of Trees and Shrubs in Dedicated Public Space

All disturbance or removal of trees and shrubs in public space shall conform to the Maryland Forest Service standards and requirements set forth in the permits for this contract.

C. Dispositions of Trees and Shrubs in Park Property

Remove trees and shrubs within the designated construction strip as shown and as specified hereinabove. Trees within the working area which are marked with yellow, orange, or white paint or are noted as to be saved on the Plans shall be saved and protected from damage.

Protect trees and shrubs outside the designated work strip on park property from defacement, injury, and damage. Transplant all dogwoods as directed by the City.

The City will, in some cases, designate the final location of trees when not shown on the plans, within park property, including replacements.

D. Disposition of Cut Logs on Private or Park Property

When the Contract Documents or special agreements require that felled trees are to be trimmed and cut into selected lengths and stored on site, the Contractor shall adhere to the following regulations:

- 1. The logs shall be stockpiled along the edge of the right-of-way or in areas requested by the property owner or agent and approved by the City.**
- 2. The area chosen shall not be within the 100-year floodplain.**

3. **The logs shall be the property of the Contractor unless otherwise noted in the Contract Documents or special agreements.**

E. Protection

Protect property pipes, stones, and monuments. Replacement, if required, shall be by a registered surveyor, at no cost to the City.

Remove fences, curb, gutter and flagstone, where required, and replace in original position or as indicated. Replace damaged facilities in kind at no cost to the City.

Protect other plants and existing improvements and facilities from damage.

F. Clearing and Grubbing

Clear all items specified herein to the limits indicated and remove cleared and grubbed material from the site. Do not start earthwork operations in areas where clearing and grubbing is not complete except that stumps and large roots may be removed concurrent with excavation. Comply with erosion, sediment control, and storm management measures specified elsewhere.

Clear and grub areas to be excavated and receiving less than three feet of fill and areas upon which structures are to be constructed, and remove imbedded stumps and root mats to a depth of not less than one foot below the subgrade or slope surfaces. Refill depressions made below subgrade or slope surfaces by the removal of stumps or roots with materials suitable for backfill.

Do not burn without written permission from the Fire Marshall and Administrative Representative. If perishable material is burned, burn under constant care of competent watchmen at such times and in such manner that anything designated to remain on the property, the surrounding cover, or other adjacent property will not be jeopardized. Comply with applicable laws and ordinances.

G. Topsoil

Strip existing topsoil from areas where excavation or grading is to be performed prior to commencement of grading or excavation, place in well-drained stockpiles in locations approved by the Engineer.

3. Measurement and Payment

Clearing and grubbing will be measured. Payment for work under this item, within the limits indicated on the Contracts Documents, will be at the Contract lump sum bid for "Clearing and Grubbing". Any tree trimming or painting of scarred surfaces shall be considered incidental to the lump sum price.

SECTION 02101

EROSION AND SEDIMENT CONTROL MEASURES

1. General

A. Description

This work shall consist of the installation of both structural and vegetative erosion and sediment control practices as indicated on the Plans. The practices shall include, but are not limited to, the use of berms, dikes, swales, silt fences, inlet protection, sediment traps and sediment basins, crushed stone, filters or other approved methods indicated on the Plans.

Erosion and sediment control measures shall be implemented any time that land is disturbed by construction activities including clearing, grading, excavating, stripping, filling or related work unless exempt by State law or local ordinance.

Application of erosion and sediment control measures shall be coordinated with the construction or permanent drainage facilities such as storm sewers, culverts, paved ditches, etc. to insure effective control of erosion from the construction site.

B. Reference Documents

The contractor shall obtain and maintain on the site at all times a copy of the 1983 Maryland Standards and Specifications For Soil Erosion and Sediment Control, available from the local Soil Conservation District.

The specific construction requirements in this document for the practices being employed are to be strictly adhered to throughout construction.

C. Permits

The Contractor shall be responsible for obtaining all required permits such as sediment control permits, grading permits and/or state environmental permits as required before beginning any work which will result in the disturbance of land.

The Contractor shall not utilize any off site areas for obtaining borrow material or for depositing spoil material unless those areas have an approved erosion and sediment control plan and all current permits as may be required by State law or local ordinance.

2. Materials

Seed, sod, mulches, fertilizer, topsoil and other materials for vegetative practices shall be as specified in Section 02950 unless otherwise specified on the approved Plans.

Aggregate and stone, filter cloth, gabion baskets and concrete materials for slope and channel paving shall meet the requirements specified on the approved Plans and in Section 02270.

Rigid and flexible slope drains shall be as specified on the approved Plans or as directed by the Engineer.

Materials for pipe spillways including barrel, riser, anti-seep collars, trash racks and related items shall be as specified on the approved Plans.

3. Execution

A. Construction

The Contractor shall adhere strictly to the “sequence of construction” as tabulated on the approved Plans. If such a “sequence of construction” is not included on the approved Plans, the Contractor shall submit his schedules of erosion and sediment control work to the Engineer for approval. No work shall begin until erosion control schedules are approved by the Engineer.

Phasing of erosion and sediment control measures with the construction project, unless approved otherwise, shall be as follows:

Clear only those areas as required to construct the erosion and sediment control practices indicated on the Plans as perimeter controls and install the perimeter controls as detailed before continuing construction. Perimeter controls shall include earth berms, embankments, swales, silt fence, stone outlet structures, pipe outlet structures and sediment basins.

Proceed with clearing, stripping, grading and related construction activity to the extent that erosion from exposed surfaces can be managed effectively by the controls in place. The contractor shall endeavor to minimize the extent of exposed earth by avoiding mass grading as practical, and shall follow with stabilization immediately as finished grading is accomplished. No disturbed earth shall be allowed to remain exposed for longer than 30 days without receiving temporary stabilization with seed and mulch, or mulch anchored by a mulching tool outside of the growing season.

As construction of drainage structures is completed, apply the erosion controls where detailed on the Plans for pipe entrances, inlets, etc. and apply permanent structural practices as may be indicated for grade stabilization, slope protection, open channels and swales.

B. Maintenance, Removal and Restabilization

At the end of each working day and after any rainfall event, the Contractor shall inspect all erosion and sediment control structures. Any structures found to need maintenance or repair shall be serviced immediately to insure continuous functioning. Special attention should be given to cleanout of sediment trapping devices such as silt traps and sediment basins so that minimum design storage volumes are never reduced by excess sediment.

After contributing areas become stabilized with vegetation and/or hard surfacing, the Contractor may remove the specific erosion and sediment controls protecting those areas after obtaining approval from the Engineer.

Re-stabilization of surfaces disturbed by the removal of erosion and sediment controls shall commence immediately following removal. Re-stabilization efforts shall include restoration of surfaces to required grades, topsoiling, seeding, sodding, mulching or other treatment as specified on the Plans.

4. Measurement and Payment

Erosion and sediment control items will not be measured for payment individually.

Payment will be made for the complete temporary erosion and sediment control system at the lump sum bid price.

SECTION 02130

CONSTRUCTION STAKEOUT

1. General

A Description

This work shall consist of furnishing, placing, and maintaining construction layout stakes necessary for the proper prosecution of the work under the Contract, all in accordance with these Specifications.

2. Materials

Not applicable

3. Construction Requirements

A Details Furnished

The Contractor will furnish the following prior to commencement of work by the Contractor.

1. **The roadways and structures of 20 feet (6m) or less span, which is measured along the center line or roadway, the Contractor will furnish staked center line. The maximum spacing of stations (stakes, nails, crosses, etc.) will not be in excess of 100 feet (30m), and the elevations on the top of each marked point will be furnished. The Contractor will establish appropriately spaced bench marks and the necessary references for the preservation and control of the center line. Upon completion of the grading, the Contractor will again provide a staked center line or working line, whichever is needed. An elevation for the top of each marked point will also be furnished by the Contractor, as well as one set of prints of the cross sections. When warranted by circumstances an additional set of cross sections will be furnished by the Contractor. The cross sections are to be used as guides only, it being understood that dimensions or elevations scaled there from will not be sufficiently precise for use in the construction of roadways and structures of 20 feet (6m) span or less.**
2. **For structures over 20 feet (6m) span, which is measured along the center line of roadway, the Contractor will furnish a staked center line or working line, whichever applies, with stations not over 100 feet (30m) apart and extending at least 100 feet (30m) beyond ends of the structure. When the structure is on a curve, the Contractor will furnish a staked center line or working line, whichever applies, consisting of stations not over 100 feet (30m) apart and including the P.C., P.I., and P.T., and at least one point on the tangents beyond each end of the curve. When the**

structure is on a spiral, suitable points will be given. At least two bench marks, one on each end of the structure, will be established by the Contractor.

B. Equipment and Personnel

The Contractor shall use competent personnel and suitable equipment for all engineering work required to complete the work in accordance with lines, grades, elevations, and dimensions called for in the plans.

C. Alignment Markers

The Contractor shall exercise care in the preservation of stakes and bench marks set and shall reset them at his own expense when any are damaged or destroyed.

D. Control Stakes

For roadways the Contractor shall furnish, set and preserve stakes at each station along each side of the project on the right-of-way or easement line, whichever is furthest from the center line of construction. Where one lane of an ultimate dual highway is to be constructed, the stakes on the side of future improvement shall be set 10 feet (3m) beyond the construction limits. On each of these stakes shall be marked its offset distance from the center line and its top elevation or the cut or fill to the profile grade line. Additional stakes as needed for horizontal and vertical controls necessary for the correct layout of the work shall be set by the Contractor.

E. Layout

For structures the Contractor shall proceed with his layout work. However, before any actual construction work is done, the Contractor shall rerun the lines and grades to check same and then establish all center line or working line intersections with the center line or center of bearing of all piers, bents, and abutments. From these field layouts, he shall check the proposed span lengths by chaining. Such measurements shall be compensated for temperature, sag, and horizontal alignment. He shall also check the location of the structure to affirm its correct location with relation to existing structures, roads and/or existing conditions that are to remain in their original positions. If any discrepancies are found, the Contractor shall notify the Engineer at once in writing; otherwise, it will be assumed that all planned dimensions, grades, and field measurements are correct. All lines established on the ground shall be preserved and/or well referenced, marked and kept available at all times.

The Contractor shall establish the field elevations for all bridge seats and assume responsibility for finishing same to proper grade. If any steel beams or girders are incorporated in the project, it will be the Contractor's responsibility to run elevations over the tops of such beams or girders after they are in place, before any forms are attached to them, to determine the deflection of each member. This information shall then be applied to the deflection diagram to determine the corrected elevation of bottom slab forms and screed supports.

After the Contractor has assembled this information, it will be checked by the Engineer before final adjustments are made and the placing of any concrete in said forms.

F. Utilities

The Contractor will be required to furnish to utility companies or agencies working within the limits of the project, promptly upon request, reference to control points, alignment and grade data, so that they may properly locate and coordinate their work and improvements in relation to this project.

G. Right-of-Way and Easement Lines

The Contractor will be required to define only right-of-way and easement lines of the project for property owners, promptly upon request.

H. Subgrade, Subbase, and Base Controls

The Contractor will be required to furnish for subgrade, subbase, and base courses string line and grade with fixed controls not to exceed 25 feet (7.5m) longitudinal spacing. Transverse spacing must be set for subgrade and the top course of any subbase or base course at 25 feet (7.6m). Contractor to notify City Inspector prior to placing each course for inspection of cross slope.

The Contractor will be required to place along each form line for cement concrete pavement, line and grade with fixed controls not to exceed 25 feet (7.6m).

4. Method of Measurement and Payment

This work will not be measured but will be paid for on a lump sum basis. The work will be paid for at the Contract lump sum price bid, which price shall be full compensation for all labor, materials, equipment, and incidentals necessary to complete the work.

SECTION 02200

EARTHWORK

1. General

A. Description

This section includes excavation, backfill, grading and related items to the limits indicated and directed by the Engineer, in accordance with the Contract Documents.

B. Definitions

1. **Fill material is material used for trench backfill, structural fill and backfill.**
2. **Filled areas are areas which have received trench backfill, structural fill, placed and compacted as specified herein.**
3. **Structural fill is a filled area upon or within which a structure is to be constructed.**
4. **Paved areas are areas over which paving exists, or is to be placed under Contract, or areas designated on the Plans to receive future paving.**
5. **Borrow structural fill and borrow trench backfill are suitable materials meeting requirements specified herein, excavated offsite due to unsuitability for reuse as subgrade construction of site excavated material.**
6. **Controlled blasting is excavation of rock in which the various elements of the blast (hole size, depth, spacing, burden, charge size, explosive charge weight per delay, distribution, delay sequence) are carefully balanced and controlled to provide a distribution of charge that will excavate the rock to the required contours to minimize overbreak and fracturing of the rock beyond the contour line. Smooth wall blasting, presplitting, cushion blasting and line drill are examples of operations included in the term "controlled blasting".**

C. Quality Assurance

The Contractor shall furnish a guarantee that filled areas will not suffer from ponding or settlement in excess of the following limitations for a period of one year from the date of final acceptance. The following designations are noted:

1. **Type I: (Paved areas and areas within five feet of structures) 0.05 foot.**
2. **Type II: (Unimproved areas) 0.10 foot, sloped to provide positive drainage.**

Filled areas which settle in excess of the above limitations shall be brought to the proper grade with additional compacted material or removed and replaced with suitable material at no cost to the City. Construction, paving, landscaping and other site improvements damaged by settlement shall be removed and replaced or reworked with suitable materials at no cost to the City. Such areas shall be guaranteed for an additional year to meet the settlement requirements for the area type.

D. Inspection and Testing

Perform earthwork under continuous inspection by the Engineer or his representative. Do not place fill material unless the Engineer or his representative is on the site. The Engineer shall make field density tests of the compaction of each layer of fill in accordance with one of the following: ASTM D1556; ASTM D2167; ASTM D2922; or ASTM D2937. Testing shall be as follows: one test per 100 linear foot trench and additional tests as directed by the Engineer; one test per 1000 square feet for general grading and additional tests as directed by the Engineer for general grading. Testing for water and sewer laterals shall be one test per payer of trench backfill minimum, or as directed. Contractor shall be required to test under supervision of Engineer at the expense of the Contractor. Allow time for the Engineer to perform the tests upon completion of each layer of fill in a designated area. The Contractor shall provide equipment to cut out smooth surfaced spot locations designated by the Engineer on which to perform the test. When the tests indicate that density or moisture content does not meet requirements specified herein, the particular layer or portion thereof, as determined by the Engineer, shall be reworked by rolling or by scarifying, wetting or drying and recompacting until the required density has been obtained. The Contractor/ developer/ agent will be required to submit documentation including, but not limited to, compaction test reports and soil proctors being used, as work progresses to assure compliance with the requirements of the Specifications.

Upon completion of all trench backfill and embankment fills, a final compaction test report and certification by an approved geotechnical consultant shall be provided for review and approval by the City prior to commencing construction of curbs/ roadways, etc.

Compaction test reports shall include date taken, location (MH – MH/Station), moisture content, optimum moisture, dry density, maximum density, and percent compaction. Additionally, the locations of tests are to be plotted on the profile view of the approved drawings at the depth and station they were taken.

The approved subgrade for roadway pavement shall be tested for compaction after proofrolling of subgrade.

E. Submittals

1. Blasting Data and Reports

Where indicated and when directed by the Engineer, engage the services of a qualified, independent professional blasting vibration consultant satisfactory to the Engineer to design, review, evaluate and modify the

blasting operations. Have the blasting vibration consultant design, in conjunction with the Contractor, the initial test blasts, so that maximum explosive charge weights per delay period and blasting patterns can be determined for future blasts which will maintain the vibration effects at existing structures below the specified level. Have the consultant periodically, or when requested by the Engineer, review the blasting operations and seismographic data and direct such changes in the blasting operations as are required to produce a controlled blasting operation meeting the requirements of these Specifications.

All blasting firms must show proof of license by State of Maryland to the City representative prior to commencing blasting activity.

Within ten (10) days prior to starting the work, submit the following data for the proposed blasting operations:

- a. Location, depth, area, anticipated neat lines and relationship to adjacent excavations, structures.
- b. Diameter, spacing, burden, depth, pattern and inclination of blast holes.
- c. Type, strength, amount in terms of weight and cartridges of explosives to be used in each hole, on each delay and the total of the blast.
- d. The distribution of the charge in the holes and the priming of each hole.
- e. Type, sequence and number of delays, delay pattern, wiring diagram for blast, size and type of hookup lines and lead lines, type and capacity of firing source.
- f. Stemming of holes and matting or covering of blast area.
- g. Qualifications of the person or persons who will be directly responsible for supervising the loading of the shot and for firing it.
- h. Design details of ground vibration and air blast measuring equipment.

Complete, maintain and submit permanent blast reports, including logs of each blast. Complete reports after each blast to include the following information:

- a. Date, time and limits of blast by station.
- b. Amount of explosives used by weight and number of cartridges.
- c. Total number of delays used and number of holes used for each delay period.

- d. **Total number of holes, maximum charge per hole and corresponding delay number.**
- e. **Recorded peak particle velocity and location of instrument.**
- f. **Weather conditions including wind direction and velocity.**

2. Materials

A. Fill Materials

1. General

All fill material shall be free of refuse and vegetable matter, frozen material, and other material deleterious to compaction and stability. Excavated material meeting these requirements and the requirements stipulated below for the appropriate type of placement shall be used when approved by the Engineer. Otherwise, the Contractor shall excavate, haul, and place material from approved off-site sources. Such material will be measured and paid for as “Structural Fill”, and “Borrow Trench Backfill”.

2. Trench Backfill

In general, trenches shall be backfilled with native materials exhibiting the characteristics of the adjacent natural soils. In addition, backfill up to two feet over the pipe measured at the bell shall contain no rocks or stones larger than two inches in their greatest dimension. From two feet over the pipe bell to one foot below the required subgrade, rocks up to six inches in their greatest dimension may be used providing they are contained within a sufficient matrix of soil to avoid direct contact with other rocks, do not directly contact compaction equipment, and do not exceed ten percent of the volume of the backfill material.

3. Borrow Trench Backfill

Where the excavated native materials used as backfill will not meet quality assurance requirements for settlement limits or cannot meet compaction requirements, trenches shall be backfilled with material from off-site sources. Material sources shall be approved by the Engineer. In no case shall imported backfill materials have properties in excess of the following: five percent organic content; a maximum density less than 100 pounds per cubic foot as determined by AASHTO T99, Method A; a liquid limit in excess of 35; or a plasticity index greater than eight.

4. Structural Fill and Embankment

Soil having a maximum density not less than 105 pounds per cubic foot as determined by AASHTO T99, Method A, with a liquid limit not exceeding 30, a plasticity index not exceeding six, containing no stones larger than three inches in the greatest dimension.

5. Bedding for Pipe and Pipe Structures

In general, except as specified herein pipe shall be bedded on No. 6 Stone or as directed. Where pipe manufacturer's requirements call for more stringent bedding materials they shall be followed.

- a. **Elliptical pipe shall be bedded in #10 limestone dust or sand meeting the requirements of ASTM C33.**
- b. **Plastic, spongy or unstable trench bottom shall be under cut and replaced with compacted material meeting the requirements of MSHA SRC 6 and bedded as above.**
- c. **Trenches excavated below the required depth shall be backfilled and bedded as above at no additional cost to the City.**

6. Gravel Base for On-Grade Slabs

Gravel base for on-grade slabs shall be MSHA SRC gradation two meeting the requirements of ASTM D 2940 except that the liquid and plastic limits shall not exceed 30 and 9 respectively.

7. Sheeting and Shoring

Sheeting, shoring and bracing materials shall be timber or steel of a design sufficient to retain the earth around structures, prevent cave-in and settlement, and to meet or exceed all safety requirements.

Timber shall be structural grade with minimum working stress of 1100 pounds per square inch.

Steel sheet piling shall conform to the requirements of ASTM A328, continuously interlocking type.

3. Execution

A. Excavation

1. General

All material excavated shall be non-classified whether or not indicated. Excavation shall be carried out to the lines and grades indicated on the plans. Excavation for on-grade slabs and pavements shall be sufficient to allow for fills, base and waterproofing material where indicated and required.

Excavation for planting areas shall allow for topsoil. Excavation for formed concrete shall be sufficient to allow for convenience construction and removal of forms, and to allow for application of waterproofing and curing materials where indicated.

2. Test Pit Excavation

Test pit excavation shall be performed with extreme precaution and in such a manner that no damage occurs to the facility being test pitted.

3. Rock Excavation

Whether or not rock is shown on the plans, the Contractor is responsible for making his own investigation to determine if rock is present. The presence or absence of rock shall not entitle the Contractor to additional compensation.

Blasting shall be performed only with the approval of the Engineer and after submittal of blasting data as specified hereinbefore. Control fly rock and material so as to prevent damage to persons or structures. When directed by the Engineer, use blasting mats in areas where overburden has been removed prior to blasting. Equipment used for drilling of holes shall have a positive means of dust control subject to the Engineer's approval.

Blasting shall be performed no closer than 10 feet to existing water, gas, sewer or conduit until such facilities have been completely exposed and then backfilled prior to the intersection with the areas to be blasted. In any case, blasting shall be no closer than 5 feet from exposed existing utilities 10 inches or less in diameter, and no closer than 10 feet from exposed existing utilities larger than 10 inches. Before blasting within 50 feet of concrete, submit and obtain approval of a plan showing the relative positions of the concrete, the area to be blasted, and the blasting techniques to be employed.

Use controlled blasting techniques. Modify the blasting round as necessary to achieve the best obtainable results and to keep the air blast over pressure, vibrations and noise within the limits herein specified. Exercise all possible care in drilling and blasting operations to minimize overbreak and blast damage of adjacent unexcavated ground. It shall be the Contractor's responsibility to produce a satisfactory excavated surface by determining the proper relationships of the factors of burden, spacing, depth of charge, amount and type of explosive, hole size and delay pattern, and other necessary considerations to achieve the required results.

4. Vibration and Air Blast Control

Control operations so that peak particle velocity will not exceed two inches per second measured adjacent to any structure in the vicinity of the blasting operations or the following limits for concrete:

| <u>Inches Per Second</u> | <u>Age of Concrete</u> |
|--------------------------|------------------------|
| 0.25 | 12 – 24 hours |
| 0.50 | 24 – 48 hours |
| 1.00 | 48 hours – 5 days |
| 2.00 | 5 – 7 days |

Impact or impulsive noise from blasting operations will not exceed 140 dB peak sound pressure level measured at the nearest structure or property line.

Peak particle velocity is defined as the maximum of the three velocity components of a vibration measured at any point in three mutually perpendicular directions by a seismograph approved by the Engineer, capable of producing a permanent record and capable of internal dynamic calibration.

Furnish qualified personnel to operate instruments and interpret results.

Record air blast overpressure with a peak impact recording instrument having linear frequency response.

The Contractor shall provide for repair or replacement of facilities damaged by blasting operations, at no cost to the City.

5. Removal of Unsuitable Material

Where material not meeting the requirements of fill material and deemed unsuitable by the Engineer is encountered, either contiguous to or within the proposed limits of excavation shown, the Engineer may direct its removal. Depth of removal will be determined by the Engineer.

6. Unauthorized Excavation

Where unauthorized excavations are made below indicated elevations under slabs, footings, pipes or structures, restore to proper elevations with fill materials as specified hereinbefore and as directed by the Engineer at no cost to the City.

7. Sheeting, Shoring and Bracing

Sheeting, shoring and bracing shall be placed so as not to interfere with the construction work and shall be entirely independent of all footings and structures.

Remove sheeting, shoring and bracing and all wood forms unless otherwise directed by the Engineer in writing concurrently with backfilling operations in a manner that precludes settlement of the backfill excavation.

Place and remove sheeting and shoring as required to assure safe working conditions and prevent accidents and cave-ins.

8. Trench Excavation

Excavate trenches to the width and depth indicated on the plans. Provide uniform and continuous bearing and support for pipe or structure on granular bedding. Remove rock, when encountered, to a minimum depth of six inches below the pipe, and the same depth below the bell. If the external shape of the trench cannot be preserved or the trench varies from the shape of the structure, the space between the desired trench dimensions

and the bottom of the excavation as made shall be filled with gravel backfill as specified hereinbefore, allowing for placement of granular bedding where specified. Material deemed unsuitable by the Engineer in the bottom of the trench shall be removed and replaced with gravel backfill. Depth and width of removal shall be as directed by the Engineer. Perform excavation in the immediate vicinity of adjacent and contiguous facilities by means that will not damage the facility. Damage caused to existing facilities by the Contractor's operations shall be repaired at no expense to the City.

Trench excavation shall proceed no more than 75 feet in advance of the placing of backfill unless otherwise authorized by the Engineer, to the widths and depths shown on the plans. The Engineer may require backfilling and subsequent re-excavation on trenches left open an unreasonable amount of time in advance of laying of pipe, at no expense to the City. Trenches left open overnight, or during periods when the Contractor's forces are not present, shall be so protected or enclosed and marked as to cause no danger to the public or others.

Side of trenches in improved public ways and adjacent to other structures shall be practically plumb. Where permitted by the Engineer, sides of trenches in other areas may be sloped from a point one foot above the top of the pipe to grade. Such slope shall be at no additional cost to the City. Slopes shall be such as will not allow displacement of material or danger to personnel. Bell holes shall be excavated in the bottoms of trenches wherever necessary to permit the proper making of joints.

Trench sheeting shall conform to requirements specified hereinbefore and, where sheeting is used, the trench width as shown on the plans shall be applied between the interior faces of the sheeting as driven. Remove sheeting as backfilling progresses. Compact contiguous areas concurrent with removal of sheeting. Leave sheeting in place only when so directed by the Engineer in writing. Trim such sheeting to a minimum of 1-1/2 feet below grade.

B. Backfill Operations

1. General

Do not place, spread, or compact fill material while it is frozen or thawing or place upon frozen or thawing ground or during unfavorable weather conditions. When the work is interrupted by rain, fill operations shall not be resumed until field tests indicate that the moisture content and density of the fill are within the limits specified. Any compacted layer which has been frozen shall be reworked and recompacted before the next layer is placed upon it.

2. Preparation

Before depositing fills, remove all vegetative matter, mud, muck and otherwise unsuitable soils from the surfaces upon which fill materials are to be placed and fill irregularities and cavities.

Completely fill boring voids and test pit excavations within the limits of excavation with sand, lean concrete, or crushed stone up to the level of the proposed subgrade, as directed by the Engineer.

3. Placing Fill Material for Structural Fills

Compact the surface upon which the fill material is to be deposited to the density specified hereinafter for compaction of fill.

Where embankments are made on hillsides or slopes, step or bank the slope of the original ground upon which the fill is to be placed when so directed by the Engineer.

Prior to placing material, based upon test results, determine if the material can be satisfactorily compacted at its existing moisture content. Adjust moisture content by aerating or adding water prior to compacting. In-place moisture content after compaction shall not exceed two percent from optimum.

Place fill material in uniform lifts of not more than eight inches in uncompacted thickness. Spread each layer uniformly and evenly. Perform compactors or other equipment and methods approved by the Engineer. Jetting or puddling of backfill will not be allowed.

Compact each layer to not less than 95 percent density per AASHTO T-180.

If the required compaction cannot be obtained after three tests, the material shall be re-excavated and mixed with additional soil materials prior to its reuse as structural fill.

Continue filling operation until the fill has been brought to the finished slopes and grades shown on the contract drawings, making proper allowances for thickness of topsoil, pavement slabs. Construct fill so that surface will be sloped to drain at all times and deposit fills so as to prevent excessive moisture accumulation from rain water.

Compaction by rollers or heavy equipment will not be permitted within a five foot strip adjacent to structures.

4. Placing Trench Backfill

Placing trench backfill shall conform to requirements specified hereinbefore for placing structural fills, modified as follows:

Place granular bedding in accordance with the plans and as specified herein. Compact up to one foot above top of pipe by manual tampers in maximum six inch layers. The contractor may continue the granular bedding to one foot above the top of the pipe in lieu of placing backfill in six inch layers.

In Type I areas under existing paving: Complete backfill and compaction in not more than eight inch lifts to not less than 95 percent maximum density, per AASHTO T-180, at a moisture content within two percent for the material as determined by the listed AASHTO method. Prior to commencing

compaction, fills shall be brought to specified water content by either aerating the material if it is too wet, or spraying the material with water if it is too dry.

In Type I areas under future paving and within public right-of-ways, complete backfill in not less than eight inch lifts and compact to 95 percent density as per ASSHTO T-99 at a moisture content that is +/- 2 percent of optimum.

In Type II areas, complete backfill in not less than 12 inch lifts and compact to 90 percent density as per ASSHTO T-180 at a moisture content that is +/- 2 percent of optimum.

When sand or gravel borrow trench backfill material meeting requirements specified elsewhere herein is utilized, life height requirements will be determined in the field based on test sections and tests prescribed and observed by the Engineer and based on type of compaction equipment. Backhoe buckets will be permitted for gravel consolidation only.

In new subdivision work where water and sewer connections are to be placed in the same trench backfill to the elevation necessary for construction of the water service prior to placing backfilling over the water service. If water and sewer service connections cannot be constructed concurrently, separate trenches will be required.

C. Finish Grading

Perform grading operations so that the excavation will be well drained at all times. Maintain drainage ditches open and free from soil, debris and leaves until final acceptance of the work. Finish all grading on neat, regular lines conforming to the sections, lines, grades and contours shown on the plans or, if not shown, in accordance with the criteria set forth hereinafter. Perform grading work in proper sequence with all other associated operations.

Structures and pavement. Bring finished subgrade to the elevation as shown on the drawings. Bring entire area to the finished subgrade elevation before excavating for footings.

Grading criteria for structures greater than 20 feet in maximum dimension. If not otherwise indicated in the Contract Documents, place fill at a minimum slope of two percent for a minimum of 10 feet beyond the exterior wall or exterior face of the structure. From the edge of the 10 foot extension, slope to existing grade at a maximum slope of 1:2.5.

Uniformly grade all areas disturbed by the project at trench locations, excavation and fill areas, and adjacent transition areas so that finished surfaces are at the proposed grade or are approximately at pre-existing grades, adjusted as required to provide drainage.

D. Material Storage

Deposit excess excavated material and unsuitable material offsite. Stockpile topsoil in a location approved by the Engineer. Use of offsite premises: Any

land and access thereto not furnished by the City that the Contractor deems necessary for the contract work—for temporary construction facilities, access and egress, or for storage of materials – shall confine his apparatus and storage to such additional areas as he may provide at his expense. The Contractor shall obtain permits and written approvals from the appropriate jurisdictional agency and property owner for use of premises not furnished by the City as described above, and of all off-site areas which include offsite borrow pits and waste areas; such permits and approvals must specify treatment of said areas during and at the completion of construction. Copies of all permits and approvals shall be furnished to the Engineer before utilization of the areas.

E. Dewatering and Drainage

If water is encountered in excavation, provide pumps of sufficient capacity to remove the water while the excavations are being made and until the concrete footings have been poured, the foundation walls or other structures erected up to grade, or until the excavation has been backfilled. Do not allow sediment laden water to flow into any watercourse or drainageway or over land without first filtering it through an approved desilting device. Use of woven and non-woven filter material will be allowed when approved by the Engineer.

Provide all necessary temporary surface drainage and keep the same operating to the satisfaction of the Engineer until permanent drainage or finish grading has been completed. Do not allow damming or ponding of water in gutters or storm drains.

F. Restoration of Surface Facilities

The Contractor shall restore and restabilize surface features and facilities damaged or destroyed during construction to at least the condition existing before construction, in accordance with information provided in applicable sections of these Specifications.

4. Measurement and Payment

A. Excavation and Backfill for Utility Structures and Trench Excavation and Backfill

Excavation and backfill for utility structures and trench excavation and backfill with approved material excavated from the bottom of the trench or the lower level of the granular bedding where indicated, will not be measured separately for payment but the cost thereof will be included in the unit prices bid for the particular utility facility.

Excavation and backfill for utility structures and trench excavation and backfill in excess of the limits described above will not be paid for except as authorized in writing by the Engineer.

B. Borrow Trench Backfill, Borrow Structural Fill and Borrow Embankment

Borrow trench backfill, borrow structural fill will be measured by the compacted volume in cubic yards actually placed, as determined from the locations indicated on the plans and indicated in the Special Provisions.

Payment for borrow structural fill and borrow trench backfill will be made for the quantities measured for the type required at the unit prices per cubic yard listed in the Bid Schedule.

Borrow material from beyond 3000 feet from the project area will be considered payable borrow at the unit price per cubic yard.

Payment for borrow trench backfill will include disposal off-site of unsuitable material.

Payment for borrow structural fill will include excavation and disposal off-site of unsuitable material.

C. Granular Bedding

Granular bedding for pipe and structures will not be measured for payment but the cost thereof shall be included in the unit price per linear foot in the bid schedule for pipe, specified under other sections, and in the unit price for sheeting where required.

D. Gravel Backfill Below Subgrade

Excavation of unsuitable material and replacement with gravel backfill below subgrade at the direction of the Engineer will be measured by the cubic yard actually replaced, and payment will be made for the quantity measured at the fixed contingent unit price per cubic yard listed in the Bid Schedule.

Payment will include excavation and disposal off-site of unsuitable material.

E. Sheeting Left in Place

Sheeting left in place at the direction of the Engineer will be measured by the thousand board foot of sheeting actually placed, regardless of material, and payment will be made for the quantity measured at the fixed contingent unit price per thousand board feet listed in the Bid Schedule. Payment will include cost of additional granular bedding material required due to the use of sheeting.

F. Test Pits

Test pits in the numbers, at the locations, and to the limits directed by the Engineer shall be measured by the cubic yard of excavated material removed. Those portions of the test pits not backfilled but utilized as trench excavation shall not be measured for payment as test pits but the cost thereof shall be included in pipe prices bid.

Payment will be made for the quantities measured at the fixed contingent unit prices per cubic yard listed in the Bid Schedule.

Payment will include backfill and material as specified hereinbefore.

G. Non-Payment Items

The following items of work will not be measured for payment but will be considered as incidental to the Contract:

- 1. Dewatering, watering**
- 2. Finish grading**
- 3. Preparation of subgrade**
- 4. Compaction**
- 5. Sheeting and shoring, for the convenience of the Contractor**
- 6. Blasting**
- 7. Removal of excess material**
- 8. Gravel base under slabs**
- 9. Placing structural fill using suitable materials available on-site**

SECTION 02270

SLOPE AND CHANNEL PROTECTION

1. General

A. Description

This section includes providing concrete and stone protection for slopes, ditches, and channels to the configurations and extents indicated in accordance with the Contract Documents.

B. Submittals

Submit test list reports as specified before delivery of materials, for the items listed below:

1. **Aggregate and Stone**
2. **Plastic Filter Cloth and Fasteners**
3. **Wire for Gabion Baskets**
4. **Concrete Materials**

Provide certified delivery tickets for the rip-rap stone guaranteeing compliance with specified gradation requirements.

2. Materials

A. Concrete

Concrete for ditches, channels, and slope protection shall be 4000 psi concrete, reinforced with welded wire fabric meeting requirements of ASTM A185, 6 x 6, W3 x W3. Concrete and appurtenant materials shall be in accordance with requirements specified elsewhere in these Specifications.

B. Stone for Slope Protection

Stone for rip-rap and gabions shall be hard, durable, angular in shape, resistant to weathering and to water action, free from over-burden, spoil, shale, slate, and organic material, and shall meet the requirements specified. The maximum dimension shall not exceed four times the minimum dimension.

Stone shall meet the following test requirements in accordance with AASHTO T85 and T104:

| | |
|--|-------------|
| Minimum apparent specific gravity | 2.5% |
|--|-------------|

| | |
|--|-------|
| Maximum absorption | 3.0% |
| Maximum sodium sulfate loss in 5 cycles in 2-1/2 – 1-1/2 inches size for class 3 stone | 20.0% |
| All others | 12.0% |

Filter material shall consist of sand, gravel, or crushed rock with gradation as specified in the Special Provisions. Materials shall be composed of tough durable particles, reasonably free of thin, flat, and elongated pieces, and shall contain no organic materials or soft friable particles.

C. Mortar

Mortar shall meet the following requirements:

| | |
|-----------------|------------|
| Sand | ASTM C-144 |
| Portland Cement | ASTM C-150 |

Woven filter cloth shall be composed of polypropylene monofilament yarns woven into sheets of approximately 16 mils thickness. The tensile strength of the cloth shall be as determined by ASTM D1682. Designated test shall be 350 pounds per inch in warp and 190 pounds per inch in fill or greater. The weave of the filter cloth shall be dense and tight so that in plain view the openings can only barely be seen. Test results shall indicate that the filter cloth can effectively retain particles coarser than the opening of U.S. sieve mesh 140 for all conditions of flow employed in the investigation and can retain much smaller particles when employed with soils subjected to laminar flow. Tests shall also demonstrate that the filter permeability is between 3.3 and 3.8×10^{-2} centimeters per second.

Non-woven filter material shall be composed of strong, continuous filament, rotproof, polymeric fibers oriented into a stable network in such a manner that the fibers retain their relative positions with respect to each other. The fabric shall be free of chemical treatment or coating, and shall have no flaws or defects which significantly alter its physical properties. The following fabric physical property requirements shall be met:

| | |
|-----------------------------------|-------------------------|
| Water Permeability | 10^{-2} cm/sec (min.) |
| Average Pore Size | 0.15 mm (100 sieve) |
| Grab strength * (ASTM D1682) | 90 lbs. (min.) |
| Grab Elongation * (ASTM D0682) | 75% (min.) |
| Fabric Toughness (GS x GE) | 9,000 (min.) |

* **Note: Grab strength and elongation test shall be run on wet samples soaked 24 hours in ambient temperatures.**

Stone shall meet the following gradation requirements:

Class A

| | |
|-------------------------|---------------------------------------|
| 150 lbs. or more | Minimum 70% of total by weight |
| 100 lbs. or less | Maximum 10% of total by weight |

Class B

| | |
|-------------------------|---------------------------------------|
| 500-900 lbs. | Minimum 60% of total by weight |
| 300 lbs. or less | Maximum 10% of total by weight |

Class I

| | |
|-----------------|--------------------------------------|
| 150 lbs. | 100% smaller than size listed |
| 100 lbs. | 80% smaller than size listed |
| 50 lbs. | 50% smaller than size listed |
| 2 lbs. | 10% smaller than size listed |

Class II

(Well Graded Stone)

| | |
|-----------------|--------------------------------------|
| 700 lbs. | 100% smaller than size listed |
| 500 lbs. | 80% smaller than size listed |
| 200 lbs. | 50% smaller than size listed |
| 20 lbs. | 10% smaller than size listed |

Class III

(Well Graded Stone)

| | |
|------------------|--------------------------------------|
| 2000 lbs. | 100% smaller than size listed |
| 1400 lbs. | 80% smaller than size listed |
| 700 lbs. | 50% smaller than size listed |
| 40 lbs. | 10% smaller than size listed |

Class IV

| | |
|-----------------------|----------------------|
| For 6" gabions | 3" – 5" stone |
|-----------------------|----------------------|

Class V

| | |
|---|-----------------------|
| For 9" gabions | 4" – 7" stone |
| For 12" gabions | 4" – 7" stone |
| For 18" gabions | 4" – 7" stone |
| For 36" gabions (and larger) | 4" – 12" stone |

D. Wire Baskets for Gabions

1. General

Wire baskets for gabions are compartmented, rectangular containers of galvanized steel hexagonal wire mesh, with or without protective coating, and filled with stone for slope or channel protection. Wire baskets used for slope protection shall be as indicated.

2. Dimensions and Fabrication

Wire baskets for slope and channel protection shall comply with the requirements of Table 1. All dimensions noted in the table are subject to a tolerance of + three percent (3%) of the manufacturer’s stated size.

TABLE I

| Description | Length (Multiple of Feet) | Minimum Horizontal Width of Each Unit* | Wire** | | Min. Length of Individual Compartments (Feet) |
|---------------------|---------------------------------|---|---------------------------|--|--|
| | | | PVC Coating | Opening | |
| Class IV Rip-Rap | 2 | 6' | Required for 9" Mat | 2.25" +/- .25" by 3.00" +/- .25" | 2 |
| Class V Rip-Rap | 3-3.25 | 3' | Required | 3.00" +/- .25" by 4.00" +/- .25" | 3 |

* All baskets of uniform size

** Woven into triple twisted hexagonal mesh

3. Basket Compartments

These units shall be subdivided into compartments of the required minimum length extending over the full width of the basket by inserting partition of the same mesh as basket. The partitions shall be secured in proper position to the base.

4. Fabrication

Wire basket units shall be fabricated in such a manner that the base sides and lids can be assembled at the construction site into a rectangular unit of the specified size. The basket units shall be manufactured such that the base, lids, ends, and sides shall be either woven into a single unit or one edge of these members shall be connected to the base of the basket unit in

a manner such that the strength and flexibility at the point of connection is at least equal to that of the mesh. All perimeter edges of the mesh forming the basket unit shall be securely selvaged or bound so that the joints formed by tying the selvages have at least the same strength as the body of the mesh.

Prefabricated wire ties or connecting wire shall be supplied in sufficient quantity to fasten securely all edges of basket and partitions. The wire ties or connecting wire shall meet or exceed the same specifications as the wire used in the mesh, except that the diameter of the core shall be of U.S. Steel Wire Size No. Wo.5, minimum for channel protection baskets.

5. Wire and Wire Mesh

The wire mesh shall be made of galvanized, coated steel wire with a minimum size of U.S. Steel Wire, Size No. Wo.5, for slope mats, and No. W1.0 (core only) for channel mats. The tensile strength shall be from 60,000 to 85,000 psi as determined by ASTM A 392, B Fabrication.

The wire mesh shall have sufficient elasticity to permit elongation of the mesh equivalent to a minimum of 10 percent of the length of the section of the mesh under test without reducing the gage or tensile strength of individual wires to values less than those for similar wire one gage smaller in diameter.

A section of the mesh six feet long and not less than three feet wide, after first being subjected to the elongation test described above, shall withstand a load test of 6,000 pounds applied to an area of one square foot approximately in the center of the section under test, as follows:

An uncut section of mesh six feet long, not less than three feet wide, and including all selvage bindings, shall have the ends securely clamped for three feet along the width of the sample. When the width of the sample under test exceeds three feet, the clamps will be placed in the middle portion of the width and the excess width will be allowed to fall free on each side of the clamped section. The sample shall then be subjected to sufficient tension to cause 10 percent elongation of the sample section between the clamps. After elongation and while clamped as described above and otherwise unsupported, the section shall be subjected to a load applied to an area of one square foot approximately in the center of the sample section between the clamps, and in a direction perpendicular to the direction of the tension force. The sample shall withstand, without rupture of any wire, or opening of any mesh fastening, an actual load, so applied, equaling or exceeding 6,000 pounds. The ram head used in the test shall be circular with its edges beveled or rounded to prevent shearing of wires.

6. Single Strand Cut

The wire mesh shall be fabricated in such a manner as to be non-raveling. This is defined as the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire in a section of mesh is cut and the section of mesh is then subjected to the load test described in the elasticity test above.

7. Zinc Coating

The minimum zinc coating shall be 0.80 ounces per square foot as determined by ASTM A90.

8. PVC Coating

Where indicated galvanized steel wire shall be additionally coated with a minimum of 0.4 mm (0.0157 in.) of black PVC, which shall be suitable to resist destructive effects of immersion in acidic salt, or prolonged exposure to ultraviolet light and abrasion and retain these characteristics after a period of not less than 3,000 hours under test in accordance with ASTM E42.

E. Wooden Anchor Stakes

Wooden anchor stakes shall be approximately two inches square and 3-1/2 feet long, and shall be approved by the Engineer.

3. Execution

A. Concrete Channels, Ditches, and Slope Protection

Concrete construction is specified in a separate section of these Specifications. Grade, trim, tamp, and prepare surface to receive concrete to the elevations required by the Plans. When temperatures are expected to fall below 40 degrees Fahrenheit within the first four days after the pour, protect work by covering with one foot of straw, hay, or mulch covered with securely anchored canvas or thick plastic sheets.

Place concrete in accordance with the details and to the limits shown on the Plans. Provide joints as indicated, in true alignment. Finish edges and all joints with an approved edging tool with a 1/4 inch radius. Provide 1/2 inch expansion joint material and sealer at expansion joints and where concrete abuts existing and other materials. Screed top surface with a wooden screed and finish with a wood float.

Construct slope protection in alternate strips with construction joints all in one direction perpendicular to weakened plane joints resulting in a pattern of squares from three to five feet wide. Construct curved slope protection with construction joints horizontal and plane joints vertical.

B. UngROUTED Rip-Rap

1. Class A Rip-Rap Stone (Placed Rip-Rap)

Remove unsuitable subgrade material and replace with suitable material as specified when directed by the Engineer. Excavate footing trench along the toe of the slope where indicated on the Plans. Place larger rock in the footing trench. Place rocks with their longitudinal axis normal to the embankment face and arrange so each rock above the foundation course

has a three-point bearing on the underlying rock layer. Place rip-rap to provide a minimum of voids. Bearing on smaller rocks which may be used for chinking voids will not be permitted. Local surface irregularities of the slope protection shall not vary from the planned slope by more than six inches measured at right angles to the slope.

2. Class B Rip-Rap Stone (Placed or Dumped Rip-Rap)

Remove unsuitable subgrade material and replace with suitable material as specified in Section 02200 of these Specifications, when directed by the Engineer. Excavate footing trench along the toe of slope as indicated for placed rip-rap. Place larger rocks in the footing trench and on the outside surface of the slope protection. Place rocks to provide a minimum of voids. Rock may be placed by dumping as specified hereinafter and may then be spread in layers by bulldozers or other suitable equipment. Local surface irregularities of the slope protection shall not vary from the planned slope by more than one foot measured at right angles to the slope.

3. Class I, II, and III Rip-Rap (Dumped Rip-Rap)

Remove unsuitable material and replace with suitable material as specified in Section 02200 of these Specifications, when directed by the Engineer. Excavate footing trench along toe of slope where indicated and rough grade to the limits indicated on the plans.

Where plastic filter cloth is required, proceed as follows: Place sand where indicated at the thickness and to the extent indicated on the Plans. Place plastic filter cloth loosely laid over the filter sand. Lap strips a minimum of 12 inches. Place strips parallel to the flow and slope. Anchor sheets with securing pins inserted through the cloth along but not closer than two inches to each edge and at laps as required to prevent displacement before or during construction. Where filter cloth is required below water line, alternate methods of anchorage will be considered upon submittal to the Engineer. Provide minimum six-inch horizontal laps. Stagger vertical laps a minimum of five feet. Filter cloth damaged or displaced before, during, or after placement shall be replaced and repaired by the Contractor at no cost to the City. Place gravel filter material, gradation as specified elsewhere, to the depths indicated, where required.

Place rip-rap on subgrade or gravel filter material to its full specified thickness and to the extent shown on the Standard Details in one operation in such a manner as not to disturb underlying material. Placing in layers and dumping in chutes will not be permitted.

The larger stones shall be well distributed and compacted. Hand placing or rearranging of individual stones by mechanical equipment may be required to secure the required results. Local surface irregularities shall not vary from the planned slope by more than one foot measured at right angle to the slope.

Where rip-rap and filter material are dumped under water, thickness of layers shall be increased as indicated on the Plans and methods shall be employed that minimize segregation.

C. Grouted Rip-Rap

Use Class A rip-rap stone unless otherwise indicated. Excavate footing trench along the toe of the slope as indicated on the Plans. Remove unsuitable subgrade material and replace with suitable material as specified in a separate section in these specifications, when directed by the Engineer. Place larger rock in the footing trench. Place rocks with their longitudinal axis normal to the embankment face. Place stones with joints as close as practicable, and fill the spaces between the larger stones with stone of suitable size, leaving the surface reasonably smooth and tight, and conforming to the required section. Take care to keep earth or sand from filling the spaces between the stones. After the stones have been placed, fill spaces between the stones with grout consisting of one part Portland cement to three parts sand. When the grout has partially hardened, sweep the surface with a stiff broom to remove grout extending above the surface of the rip-rap, as well as grout that has covered the surface of the stone.

D. Gabions

1. Class IV Stone-Filled Gabion Slope Protection

Form slopes and other areas to the neat lines and subgrade indicated. Remove unsuitable subgrade material and replace with suitable material as specified in Section 02200 these specifications, when directed by the Engineer. Cover compacted subgrade with plastic filter cloth as specified elsewhere in this section. Cut holes the size of wooden anchor stakes through filter cloth and drive wooden anchor stakes to anchor gabion units in place.

Assemble each gabion unit by binding together all vertical edges with wire ties on approximately three-inch spacing or by a continuous piece of connection wire looped around the vertical edges with a coil approximately every three inches.

Set empty units to line and grades indicated on the Plans. Secure units together in the same manner as described for assembling. After setting gabions to line and grade, stretch to remove any kinks from the mesh and to hold alignment. A standard fence stretcher, chain fall or iron rods may be used for this operation.

Fill gabion units with stone placed by hand or machine, to produce a minimum of voids between stones and avoid bulging of mesh. Do not drop stone from height of more than 24 inches into units. Place a minimum of two courses of stone.

After filling a gabion unit, bend lid over until it meets the ends of the unit. Secure lid to the sides and ends with wire ties or connecting wires in the manner described previously for assembling.

Cut gabion units to fit when directed by the Engineer.

2. Class V Stone-Filled Gabion Channel Protection

Provide Class V stone-filled gabion channel protection as specified herein for Class IV stone-filled gabion slope protection except as modified below.

Delete plastic filter cloth. Cut, shape, and fit the wire basket units at existing box culverts and endwalls, and place on prepared subgrade.

E. Sodded Ditches

Construct ditches to the lines and grades shown on the plans or as necessary. Provide and install sod as specified in Section 02930 of these specifications.

F. Maintenance

The Contractor shall maintain rip-rap, gabion, and concrete slope protection until completion of the project. Damage before completion from any cause shall be repaired or replaced at no cost to the City.

4. Measurement and Payment

A. Concrete Ditches, Channel and Slope Protection

Concrete ditches, channel and slope protection shall be measured by the square yard of finished surface completed in place measured parallel to the surface.

Payment will be made for the quantities measured at the unit price per square yard listed in the Bid Schedule.

Payment will include subgrade preparation, reinforcing joint treatment, and all incidentals necessary to produce the finished products.

B. Rip-Rap and Gabion Channel and Slope Protection

Rip-rap and gabion channel and slope protection shall be measured by the square yard of finished surface completed in place for the various types and classes of stone.

Payment will be made for the quantities measured at the unit price per square yard of the various types and classes of stone listed in the Bid Schedule.

Payment will include subgrade preparation, filter materials, wire baskets and grout, and all incidentals necessary to produce the finished product.

SECTION 02301

BORED AND/OR JACKED PIPE

1. General

This section includes provisions for boring and/or jacking carrier or casing pipe beneath roadways and railways, and preparation of bored holes for insertion of carrier pipe; as indicated on the Plans in accordance with the Contract Documents.

A. Submittals

Submit detailed drawings including proposed method of boring and advancing casing or proposed method of preparing bored hole for installation of carrier pipe, size, capacity and arrangement of equipment, method of dewatering, size and location of pit including configuration, backstop, pit base material and type of cutter head, proposed method of monitoring and controlling line and grade. Do not proceed with boring/jacking work until drawings have been reviewed and returned by the Engineer.

Submit shop drawings in accordance with Section 01200 including bulkhead details and proposed positive method of anchoring carrier pipe to prevent floatation.

B. Job Conditions

Bore so as not to interfere with, interrupt or endanger roadway or railway operations above.

Comply with all applicable jurisdictional codes and MOSHA requirements.

C. Additional Criteria for Work Under Railroads

For work under railroads, comply with Specifications for Pipeline Occupancy of Consolidated Rail Corporation Property, CE – 8.

D. Definitions

Boring and/or Jacking Casing pipe is a method of installing a casing pipe by means of cutting or boring an opening ahead of the pipe and forcing the pipe through the opening with hydraulic jacks.

Tree-Boring Carrier pipe is a method of installing carrier pipe by means of horizontal boring without use of casting pipe.

(2) Materials

A. Casing Pipe

Casing pipe shall be steel pipe, smooth walled, and shall have a minimum yield strength of 35,000 PSI. Minimum wall thickness shall be as indicated on the plans and/or Bid Schedule.

Joints shall be fully welded around the circumference of the pipe.

Provide bituminous coating when indicated on the Plans, meeting requirements of MIL P23236P, Class 2.

Provide lead casing with beveled and square ends.

B. Carrier Pipe

Carrier pipe shall be as shown on the detailed plans.

C. Concrete and Grout

Concrete for invert or cradle shall be 3000 psi cement concrete as specified in Section 03300 of these specifications.

Grout is specified in Section 02302 of these Specifications.

3. Execution

A. Preparation

Excavate pits as required in accordance with the detail drawings specified hereinbefore and as specified in Section 02200 of these specifications.

Perform preliminary work including constructing backstop, placing guide timbers and placing boring apparatus.

B. General

If an obstruction is encountered during installation which stops the forward action of the pipe, notify the Engineer immediately if it becomes evident that it is impossible to advance the pipe, operations will cease and the pipe shall be abandoned in place and either filled completely with grout or plugged.

Where water is known or expected to be encountered, maintain at the site pumps of sufficient capacity to handle the flow on a 24-hour basis until in the judgment of the Engineer, their operations can safely be halted.

Maintain close observation to detect settlement or displacement of surface facilities. Should settlement or displacement be detected, notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.

C. Boring

Provide removable auger and cutting head arrangement.

Overcut by cutting head shall not exceed the outside diameter of the pipe by more than 1/2 inch.

Arrange face of cutting head to provide reasonable obstruction to the free flow of soft or poor material.

Push the pipe with boring auger rotating within the pipe to remove the spoil.

Grout in the ends of pipe to a minimum depth of six inches all around.

D. Field Quality Control

When boring carrier pipe, or preparing bored hole for insertion of carrier pipe, maintain the line and grade indicated on the plans within a tolerance of two inches.

Where boring casing pipe, maintain line and grade so as to provide a minimum concrete cradle thickness of four inches.

E. Installation of Carrier Pipe

Install carrier pipe as shown on the detailed drawings.

Concrete cradle shall be as shown on the detailed drawings.

4. Measurements and Payment

A. Bored and/or Jacked Casing Pipe

Bored and/or jacked casing pipe will be measured for payment by the linear foot of each diameter measured along the centerline of the pipe between inside faces of boring pits.

Payment will be made for the quantities measured at the unit prices per linear foot listed in the Bid Schedule.

Payment will include excavation, backfill, pits, casing pipe, carrier pipe and boring equipment.

B. Tree Bored Carrier Pipe

Tree-bored carrier pipe will be measured for payment by the linear foot of each diameter measured along the centerline of the pipe between the limits included on the plans or directed by the Engineer.

Payment will be made for the quantities measured at the unit prices per linear foot listed in the Bid Schedule.

Payment will include excavation, backfill, pits, boring equipment, provision of sewer carrier pipe, and installation of water carrier pipe.

C. Non-Payment Items

The following items will not be measured for payment but will be considered as incidental to the Contract:

- 1. Monitoring of Movement**
- 2. Dewatering**

SECTION 02302

EARTH TUNNELING

1. General

A. Description

This section includes construction of earth tunnels 60 inches and larger, furnishing and installing tunnel liners, necessary dewatering and monitoring of movement, to the limits indicated and in accordance with the Contract Documents.

B. Quality Assurance

1. Fabricator Qualifications

Where fabricated segments for tunnel lining are to be used, the segments shall be fabricated by a qualified firm with a minimum of five years experience of similar type manufacturing and which has performed at least three representative jobs three years or older of comparable type of service and size to the project.

2. Tolerance

Variation in thickness of liner plates shall be +/- 0.01 inch maximum.

Fabricate similar segments with such accuracy and uniformity in dimensions that segments will be entirely interchangeable not only in individual rings but with similar segments of other rings. Space holes accurately so that any two rings can be bolted up in any relative position with same size bolts in every bolt hole.

Locate grout holes to a tolerance of +/- 0.50 inch. Provide bolt holes to a diameter tolerance of +/- 0.02 inches.

In making the taper offset ensure that the dimensions between the bolt pad and the flange face are not increased by more than 9/16 inch or decreased by more than 1/16 inch from the dimensions indicated, provided bolt length is adjusted accordingly.

Replace or correct any segment which does not comply with the tolerances indicated.

C. Submittals

Submit working drawing with pertinent descriptions, soils data, methods of dewatering, methods of excavation and support system and the proposed tunnel access pits for approval. Include all additional soils information and

locations of surface and subsurface settlement markers if not indicated elsewhere.

Submit shop drawings as specified in Section 01102 for tunnel linings showing sizes, shapes, methods of attachment and connection details, and details of grout holes.

Tunneling method

Bid shall be based on tunneling by use of tunnel shields.

Submit complete detail drawings of the shield and an adequate description of the proposed method of erecting, placing and operating the shield.

The Contractor may submit an alternate method for performing tunneling operations on the Substitution Form to the Engineer for approval.

At the request of the Engineer, submit complete details of alternate method and pertinent calculations. Should the Engineer approve an alternate method, submit shop and working drawings as directed by the Engineer.

Submit certified test reports before delivery of materials as specified in Section 01103 for the items listed below.

Gravel Packing

Liner Plate Segments for Tunnel Lining

Tunnel Liner Plate Connectors

Protective Coatings

Access Shaft Design

1. **When Contract Documents do not include access shaft design, submit working drawings for access shaft design for approval.**
2. **When Contract Documents include access shaft designs, the Contractor may submit alternate access shaft redesigns equal to or greater in size than those indicated. Shaft redesign and resultant additional construction costs shall be at no expense to the City.**

D. Construction Criteria

Tunnel construction shall be performed in a manner that will minimize movement of the ground in front of and surrounding the tunnel, and prevent subsidence of the surface above and in the vicinity of the tunnel. During all stages of tunnel construction, the ground shall be continuously supported and controlled in a manner that will prevent loss of ground and keep the perimeters and face of the tunnel stable.

The Contractor shall be responsible for all settlement resulting from tunnel operations and shall repair and restore damaged property to its original condition at no cost to the City.

Comply with applicable ordinances, codes, statutes, rules and regulations of the State of Maryland, SHA, applicable County building codes, affected Railroad Company, and applicable regulations of the Federal Government (OSHA 29CFR 1926).

E. Job Conditions

Maintain the tunnel air in a condition suitable for the health of the workmen at all times.

Maintain an adequate supply of straight and tapered liner segments at the site at all times.

Prevent damage to protective coatings during storage and delivery. Keep wire ropes, chains or hooks from direct contact with the coated surfaces.

Dewatering if required, shall be performed in such a manner so that no soils particles are present after initial 12 hours of pumping and to eliminate settlement around surrounding structures. Dewater into a sediment trap and comply with applicable environmental protection criteria specified elsewhere in these Contract Documents.

2. Materials

A. Liner Plate

Steel liner skin shall conform to requirements of ASTM A569. Liner plate steel shall have the minimum mechanical properties of flat plate before cold forming as follows:

| | | |
|----------------------|---|------------|
| Tensile strength | = | 42,000 psi |
| Yield Strength | = | 28,000 psi |
| Elongation, 2 inches | = | 30% |

Bolts and nuts shall conform to requirements of ASTM A307. The bolts shall have rolled threads.

Coatings:

Liner plate shall be hot dipped galvanized to meet requirements of AREA Specification for Corrugated Structure Plate Pipe, Pipe Arches and Arches.

Bolts and nuts shall be galvanized to meet requirements of ASTM A153.

Liner plate shall be bituminous coated to meet requirements of AREA Specification for Bituminous Coated Corrugated Metal Pipe and Arches. Provide prime coat as required to assure compatibility with galvanized surface.

Delete coatings for tunnels, which are to be filled with concrete after carrier pipe is in place.

B. Gravel Packing

Gravel packing shall be rounded gravel, clean and free from objectionable material graded as follows:

| <u>U.S. STANDARD SIEVE</u> | <u>TOTAL PERCENTAGE PASSING</u> |
|----------------------------|---------------------------------|
| 2/4 | 100 |
| 1/2 | 85 – 100 |
| 3/8 | 70 – 100 |
| #4 | 0 – 55 |
| #8 | 0 – 15 |
| #16 | 0 – 8 |

C. Grout

Cement shall conform to ASTM C150, Type 1.

Water shall be free from sulfates and other objectionable quantities of silt, organic matter and other impurities.

Sand shall conform to requirements of ASTM C404, Size No. 1.

Design Mix:

1. Grout shall have a minimum compressive strength of 100 psi attained within 24 hours. The grout shall remain fluid long enough to be injected through the lining and to fill the voids and shall set promptly enough to avoid grout flowing into the new annular space after the next advance.
2. The Contractor shall submit his grout mix composition and test results to the Engineer for approval prior to grouting. Test specimens of grout shall be made and tested in accordance with ASTM Designation C- 109.

D. Concrete

Concrete for cast in place invert shall meet requirement specified for 3000 lb. concrete in Section 03300 of these specifications.

Pumped concrete for filling annular spaces after carrier pipe is in place shall meet requirements of Section 02303.

E. Subsurface Settlement Indicators

Subsurface settlement indicators shall be fabricated of 2-1/2 inch diameter steel pipe casting, an inner one inch diameter extra strong steel pipe with a pipe cap and 1/4 inch diameter round head stainless steel bolts as directed by the Engineer. Fabricate in accordance with Standard Detail.

F. Filter Materials

Filter materials for dewatering shall consist of material with grain size of the following requirements:

$$R_{50} = \frac{D_{50} \text{ of filter}}{D_{50} \text{ of protected soil}} = 12 \text{ to } 58$$

Or

$$R_{15} = \frac{D_{15} \text{ of filter}}{D_{15} \text{ of protected soil}} = 12 \text{ to } 40$$

Where R = Ratio

Where D₅₀ = Diameter at 50% passing by weight

Where D₁₅ = Diameter at 15% passing by weight

G. Carrier Pipe

Carrier Pipe shall meet requirements as specified in Sections 02660 and 02700 of these Specifications.

H. Access Shaft

Materials for access shafts shall meet requirements set forth in the approved working drawings or the Plans and applicable sections of these Specifications.

I. Surface Settlement Markers

Surface settlement markers within pavement areas shall be p.k. nails.

Surface settlement markers within non-paved areas shall be wooden hubs.

2. Execution

A. Equipment

Tunneling equipment shall be U.S. Bureau of Mines approved types.

Tunnel shields shall have uniform exterior surface from leading edge of head or poling plates to the rear edge of the tail. A horseshoe shape shield may have closed or open bottom: a circular shield shall have a closed bottom.

Provide a substantially proportioned hood, projecting not less than two feet beyond the shield bottom with sufficient rear overhead or tail to provide at least 12 inches of overlap beyond the last element erected, when the shield has been shoved forward to the fullest extent possible.

The annular between the tail and the lining shall be as small as current practice indicates, but in no case shall it be greater than 1-1/2 inches.

Provide each shield with suitably designed breast-jacks or breast-tables or both, and such other bracing as is necessary to support the face of the tunnel excavation without loss of ground.

Provide on each shield a propulsion system, capable of moving the shield in a forward direction, while maintaining the construction with respect to line, grade, and direction. The propulsion system shall be designed to prevent the shield from moving backward despite a failure of any element of the propulsion system and shall avoid overstressing and distortion of the lining.

Prevent leakage of grout into the tunnel space between the shield and lining by incorporating a seal in the tail of each shield or other means acceptable to the Engineer.

Equip the shield with an erector arm or system capable of handling the largest sizes of lining and of erecting the sections of the lining to the required tolerances without damage to the lining.

B. Power Supply

All power machinery and tools, within the tunnel shall be operated by either electricity, compressed air, diesel with approved scrubber or other approved power. All electrical tools and equipment shall be grounded in accordance with the latest requirements of the National Electrical Code.

Provide temporary electric lights to properly and safely illuminate all parts of the tunnel construction area including special illuminating at the working faces. Lighting circuits shall be thoroughly insulated and separated from power circuits; and all lights shall be enclosed in wire cages. Secure all electrical permits necessary for successful completion of this work.

C. Operations by Tunnel Shields and Machines

On initial set-up, support the tunnel shields or tunneling machines on a crete cradle properly set at lines and grades which will permit the correct installation of the tunnel lining. During forward movement of the shield provide sufficient support at the excavation face to prevent movement of any materials except such materials as are physically displaced by the elements of the shield itself.

Control the face efficiently using such support procedures as breasting, poling plates, face jackets, sliding tables, either singly or in combination, spaced as necessary.

Advance excavation for the tunnel liner in increments sufficiently for the erection of one ring of liners and install liner plates immediately after each

increment of excavation. Carry on excavation in such manner that voids behind the liner plates are held to a minimum. Completely fill such voids with grout or gravel followed immediately by grout placed under pressure.

Whenever tunnel excavation is suspended or shut down, and the tunnel invert is below the level of groundwater, and there is danger of water infiltration from any source maintain one duly qualified personnel to observe conditions that might threaten the stability of the heading. Contractor may substitute acceptable observation devices such as closed circuit TV that enables continuous monitoring of conditions at the face by qualified observers from outside the tunnel.

During shut down periods, support the face of the excavation by positive means; no support shall rely solely on hydraulic pressure.

D. Installation of Tunnel Linings

Install the tunnel lining in a manner that will not damage the lining or coating.

Ensure that the edges are clean and free from material that could interfere with proper bearing.

Install bolts for liner plates in accordance with liner plates manufacturer's recommendations and retention or replace if necessary and bolt which does not meet the requirements.

Assemble liners to the lines and grades shown on the Contract Drawings or as directed by the Engineer.

E. Gravel Packing and Grouting

Where approved, gravel packing may be used to fill voids between the excavation and support system. For voids to be filled with gravel pack, place gravel in the voids behind liner plates by compressed air through a 1- 1/2 inch or two inch hose. Provide a minimum of pressure 80 psi.

Filling of voids with gravel shall generally proceed form the bottom grout hole of each ring to the top hole.

Vent air through one of the upper holes.

Fill voids in the gravel pack between the tunnel excavation and the tunnel liner with grout mix.

The grout pump and injection system shall be of a type that will deliver the grout in a smooth even flow with surge. The grouting circuit shall contain a return line to allow return of the grout from the nozzle to the supply tanks. The grouting equipment shall be capable of developing a uniform pressure of 50 psi at the grout hole connection and equipped with hoses with a minimum inside diameter of 1-1/2 inches. The grouting equipment shall have a minimum capacity of 1/2 cubic yards.

Grouting between the liner plates and excavation shall follow progressively with each adjacent set of holes provided in the liner plates.

In general, grouting shall proceed from the lowest grout hole of each ring and proceed progressively upward. When going from the lower to higher grout holes do not make connection to the higher holes until grout has completely filled the space below. Fill all voids completely within the working day with grout.

Continue grouting until grout appears in the next set of grout pipes, which shall be kept open during grouting to permit escape of air and water.

F. Concrete Invert

Place cast in place concrete invert to the limits shown on the Contract Drawings and as specified in Section 03300 of these specifications.

G. Installation of Carrier Pipe Inside Tunnel

Install pipe inside tunnel where indicated on the plans.

Pipe and joint requirements are specified elsewhere in the Contract Documents.

Provide bedding and anchorage in accordance with the plans.

Provide wooden skids or other approved devices as required to eliminate damage to pipe.

Where so indicated, fill annular space between pipe and tunnel with concrete having a maximum aggregate size of 3/8 inch. Otherwise provide positive means to prevent floatation.

H. Field Quality Control

Allowable Tolerances

For segmented tunnel linings inside dimensions of the ring measured along any diameter shall not vary by more than three percent of the lining diameter.

Construct tunnel to the line or grade indicated on the plans so as to allow a minimum concrete cradle thickness of four inches.

I. Detection of Movement

Install, maintain and make observations on a regular pattern of surface settlement markers as shown on the Contract Drawings or as directed by Engineer.

Monitor the movements of the indicators to an accuracy of 0.01 foot in accordance with an approved schedule.

Whenever tunneling occurs within 50 feet of an indicator, monitor the movements of the indicator before and after each advance of tunnel face within 50 feet of the indicator.

Report any settlement and horizontal movement immediately to the Engineer and take immediate remedial action, at no cost to the City.

J. Access Shaft Construction

Provide for removal and disposal of all materials of whatever nature encountered, placing and maintaining bracing, tunnel bullseyes, ground-water control, construction of access shaft, backfill as shown on the drawing, restoration of all disturbed areas, and all appurtenant work necessary to complete the excavation in the shaft.

Construct shafts in accordance with approved working drawings or details shown on the Plans.

Perform excavation, backfill and grading to the requirements listed herein.

Bullseyes for tunnel construction shall be adequately braced prior to breaking out or holing through as approved or directed by the Engineer.

4. Measurements and Payment

A. Tunnel Liners for Earth Tunnel

Tunnel liners for earth tunnel will be measured for payment by the linear foot of each diameter measured along the centerline of the tunnel between interior faces of access shafts. Payment will be made for the quantities measured at the unit price per linear foot listed in the Bid Schedule.

Payment will include liner plate, access shafts, excavation, graveling, grouting and concrete invert, timber bulkheads and filling annular spaces with concrete or sand where indicated. Carrier pipe installed inside the tunnel liner will be measured and paid for elsewhere in the Specifications.

B. Non-Payment Items

The following items will not be measured for payment but will be considered as incidental to the Contract.

- 1. Monitoring of Movement**
- 2. Dewatering.**

SECTION 02303

ROCK TUNNELING

1. General

A. Description

This Section includes specifications including methods of measurements and basis of payment applicable to all rock tunneling and related shaft work.

Additional requirements for specific components of rock tunneling are contained in subsequent sections as follows:

1. **Section 02330 includes specifications for contact and consolidation grouting in rock tunnels.**
2. **Section 02321 includes specifications for construction of shotcrete lining for rock tunnels.**
3. **Section 02340 includes specifications for initial, discretionary and permanent support in rock tunnels.**
4. **Section 02320 includes specifications for construction of cast-in-place concrete lining for rock tunnels.**

Definitions:

Initial support is the support system installed at the heading to minimize rock movement and loosening, and to maintain stability of the opening.

Final lining is the lining installed following and independent of excavation to satisfy requirements. Final lining, in conjunction with that initial support shown on the contract drawings, is designed to ensure permanent support of the opening.

Discretionary support is initial support additional to that shown on the Plans, installed by the Contractor at his discretion, for his convenience, or for increased safety.

Access shafts are the shafts provided by the Contractor through which construction is commenced and terminated.

B. Submittals

1. General

Schedule the work and provide the plant and equipment necessary to meet the progress requirements specified. Submit for review in writing all proposed working methods and procedures. Do not commence work in

which such methods or procedures are proposed until the Engineer has completed his review. Engineer may require modification of any working method or procedure which, in his opinion, is unsafe, might result in subsidence of the overlaying ground surface, or might interfere with or damage any adjacent structure.

2. Contractors Working Drawings

Prepare and submit detailed working drawings with pertinent descriptions, data or calculations of the proposed facilities, equipment to be utilized and method of construction. Items shall include the following: access shafts; hoisting plant, tunnel ventilation, lighting and drainage; control, handling, and disposal of water, methods of excavation and support; temporary shafts, access cuts, ramps and tunnels; breakouts; bulkheads; transportation and conveyance of muck.

Working drawings and calculations as submitted shall be sealed and signed by a Professional Engineer registered in the State of Maryland and shall convey or be accompanied by calculations or other information sufficient to completely explain the proposed method of construction, including but not limited to type of machinery and method proposed. Design calculations shall be submitted with the working drawings.

Working drawings for control, handling and disposal of water shall include the following:

- a. Design calculations
- b. Description, required capacity, installation and operation procedure, arrangement and location of all equipment and materials to be used.
- c. Location(s) of points of discharge of water.
- d. Location and size of berms, dikes, sumps and discharge lines.

Access Shaft Design

When Contract Documents do not include access shaft design, submit working drawings for access shaft design for approval. Show arrangement for muck skips, platforms, personnel elevators and utilities.

When Contract Documents include access shaft designs, the Contractor may submit alternate access shaft redesigns equal to or greater in size than those indicated on the Substitution Form. Shaft redesign and resultant additional construction costs shall be at no expense to the City.

In all cases, provide working drawings for shoring and bracing.

3. Construction Methods

Where applicable, submit details, drawings, calculations, descriptions, and construction methods with respect to the following:

- a. **Blasting pattern and length of rounds.**
- b. **Initial support including a description of the methods to be used to minimize ground movement and loosening for the various types of ground traversed.**
- c. **Construction equipment and capacities.**

4. Tunnel Boring Machines

Submit for review shop drawings showing the design, specification, method of operation and other pertinent data respecting tunnel boring machines proposed for use. Include manufacturer's machine outline and working arrangement drawings and operating procedure, and contractor's drawings for arrangement of ancillary equipment.

General:

Tunnel boring machines, if used, shall afford adequate protection against loss of ground and permit ground support adjacent to the tunnel face, as required by ground conditions.

Advance:

Method used to advance the tunnel boring machine shall ensure its correct alignment at all times, without binding or imposing excessive loads on the initial tunnel supports or upon the surrounding ground.

5. Blasting Data and Reports

Comply with requirements set forth in Section 02200 and as follows:

Submit calculations showing that ground vibrations and air blast pressures are within acceptable limits.

C. Job Conditions

Safety Requirements

Comply with applicable ordinance, codes, statutes, rules and regulations of the Federal Government (OSHA 29CFR1926), State of Maryland and applicable County building codes.

Whenever there is likelihood of endangering the excavation or adjacent structures, operate for 24 hours a day including weekends and holidays without intermission until the emergency or hazardous conditions no longer jeopardize the stability and safety of the work.

Blasting

Comply with all Federal, State, and local requirements. Blasting shall be permitted only after precautions have been taken for the protection of all persons, work and property. All adjacent structures and concrete shall be

protected by limiting the size of the blasts, by covering blasting area with blasting mats, or by other means to prevent damage from shockwaves or fly rock.

Perform blasting work only during the hours approved by the City. Obtain written permission to enter private property and furnish a copy to the Engineer.

Report any settlement or horizontal movement or damage to property immediately to the Engineer and take immediate remedial action, at no cost to the City.

Air Quality

Perform drilling and tunneling operations by methods and with equipment which will positively control dust, fumes, vapors, gases, fibers, fogs, mists, or other atmospheric impurities in accordance with safety requirements.

Provide approved instruments for testing the quality of the tunnel atmosphere and take samples under working conditions at prescribed intervals. Submit the results of the quality tests to the Engineer.

2. Materials

A. Concrete

Concrete for cast-in-place tunnel lining or invert shall meet requirements of Section 02320.

B. Carrier Pipe

Carrier Pipe shall meet requirements as in Section 02660 and 02700 of these Specifications.

C. Access Shaft

Materials for access shafts shall meet requirements set forth in the approved working drawings or the Plans and applicable sections of these specifications.

3. Execution

A. Lines and Grades

Excavate to the lines, grades, dimensions and tolerances as specified and shown, to accommodate the initial support and final lining.

Perform excavation by such methods as are required by local ground conditions. Tunnel excavation may be by use of tunneling machines or by use of conventional techniques such as drilling and blasting.

B. Equipment

Equipment for hauling and transporting shall be provided with brakes for use in transit or when idle. Back-up warning signals shall also be provided. All equipment, safety devices and controls shall comply with all applicable laws, ordinances, and safety codes.

When excavating with a tunnel boring machine, use equipment furnished with a dust shroud. Keep the intake end of the fan suction line as close to the machine as possible without interfering with other operations.

Use equipment which permits the installation of initial support no further than five feet from unsupported ground. Install initial support in accordance with the approved working drawings, and as indicated on the Plans.

Locomotives. The exhaust from diesel engine shall be passed through a scrubber that is at least as effective as a well-designed water bath scrubber.

Compressed air receivers shall meet minimum safety factor per ASME Boiler and Pressure code.

C. Power Supply

All power machinery, tools, etc., within the tunnel shall be operated by electricity, diesel, compressed air or other approved power. All electrical tools and equipment shall be grounded in accordance with the latest requirements of the National Electrical Code.

Provide temporary electric lights to properly and safely illuminate all parts of the tunnel construction area, including special illumination at the working face. Lighting circuits shall be thoroughly insulated and separated from power circuits, and all lights shall be enclosed in wire cages. Secure all electrical permits necessary for successful completion of this work.

D. Drilling and Blasting

Perform blasting as specified in Section 02200, Execution, as supplemented herein.

Peak particles velocities not exceeding three (3) inches per second may be permitted in the vicinity of cast-in-place concrete places as part of this contract. When blasting is conducted in the vicinity of structures subject to damage, the air wave pressures resulting from blasting shall not exceed 0.01 psi mean peak overpressures measured at the nearest structure. Measure the air wave pressures with an instrument making a permanent record for each blast. Design of the instrument shall be subject to review by the Engineer. Furnish qualified personnel to operate the instrument and interpret the results.

As the excavation proceeds and immediately after each blast, test the roof and walls and scale loose any/all shattered rock which is liable to fall. Carry out similar checks on previously excavated sections at least every 48 hours and recheck the support system tightening, lagging, blocking and adding rock bolts as required.

When so directed, drill feeler or pilot holes no less than 1-1/2 inch diameter ahead of the excavation to determine in advance the nature and condition of the materials to be excavated. Drill required number of holes at the location, in the direction and to a length, minimum 15 feet and maximum 30 feet, as ordered by the Engineer.

E. Temporary Ventilation

Furnish, install, operate and maintain for duration of the project a temporary ventilation system which conforms to the requirements of local and Federal regulations. Remove the system from the site when the work is completed.

F. Control, Handling and Disposal of Water

Tunneled Areas

Drain the tunnels as necessary to obtain satisfactory working conditions. Provide pumping where gravity flow cannot be secured. Have on hand at all times adequate machinery, pipe, power and supporting equipment. Adequate drains, sumps, and pumps shall be provided to facilitate handling and disposal of water and to conform with the requirements for controlling water when placing shotcrete or concrete within tunnels.

Accomplish all work in accordance with approved working drawings.

Dispose of ground and surface water into drainage channels, subject to approval by the City and other agencies concerned.

Provide necessary drainage and protect the invert with an acceptable traffic surface such as crushed or broken rock, or concrete if the ground at the invert becomes soft because of water or construction traffic; all at no additional cost to the City.

Surface Drainage

Intercept and divert precipitation and groundwater away from excavation and work through the use of dikes, curb walls, ditches, pipes, sumps or other means, as indicated in the contract documents or as directed by the Engineer.

Drainage of Excavated Areas

Provide and maintain ditches of adequate size to collect surface and seepage water which may enter the excavations.

Divert the water into sumps and drain or pump into drainage channels or storm drains, subject to the approval of jurisdictional agencies. When water is to be diverted into a storm drain, provide settling basins or other approved apparatus as required to reduce the amount of fine particles which may be carried into the drain.

If a storm drain become blocked or its capacity restricted, clean the drain at no additional expense to the City.

G. Disposal of Excavated Material

Dispose of excavated material off-site.

H. Initial Support

Initial support shall consist of rock bolts, steel supports, shotcrete, timber, or combinations thereof, and shall be installed as required. If minimum required initial support systems are not shown on the Drawings, select, subject to Engineer's review, type of initial support to be used for anticipated ground conditions.

Select, subject to Engineer's review, type of initial support to be used at each location.

Subject to Engineer's review, Contractor may, at his option and at no additional cost to the City, install at any location in the tunnel additional or heavier initial support than shown on the Drawings, provided such discretionary initial support does not infringe upon the neat line shown on the Drawings, and provided such initial support does not interfere with placement of secondary concrete, concrete or contact grout.

If slaking or swelling ground is encountered along portions of the tunnel alignment, the Engineer may order or approve placement of shotcrete, rockbolts, steel ribs and lagging, or sealant coating, or combination thereof, in such locations.

If initial support is required, keep its installation within five feet of excavated face or tail of tunneling machine and do not leave the tunnel unsupported without full initial support for longer than necessary after excavation. Stabilize the face if required.

I. Lines of Excavation

The minimum lines of excavation shown on the Contract Drawings are designated as the neat lines. No unexcavated material, timbering, or portions of steel supports except as noted on the Plans will be permitted to project within the neat lines.

J. Enlarged Line of Excavation

Due to conditions encountered during construction, the Engineer may require either a section differing from any shown on the Drawings or an enlargement in a particular location and new positions of the neat lines shall be established. Excavate these special sections or enlargements that may be directed by the Engineer at any time during the progress of the work. Additional excavation, backfill concrete and initial tunnel support required to conform to the new neat lines will be paid for as a Change Order, as specified in the General Provisions.

Enlargements for the Contractor's convenience shall be supported adequately during construction and backfilled with 4000 psi concrete. Backfill concrete

and additional initial support required by enlarged sections for the Contractor's convenience, shall be supplied by Contractor at no additional cost to the City.

Where directed by the Engineer, fill spaces between excavated surface and lagging with aggregate packing. Fill voids in aggregate packing with grout, as specified in Section 02330.

K. Excavation Tolerances

When steel ribs are used for initial support, do not permit any portion of the lagging except the clips or bolts used to attach lagging to the ribs to extend into the tunnel within the neat line as shown nor any portion of the steel rib including bracing to extend further than three inches within the neat line.

L. Invert Protection

If the ground at the invert becomes soft because of water or construction traffic, or both, the Contractor, at no additional cost to the City, shall provide necessary drainage and protect the invert with an acceptable traffic surface such as crushed or broken rock, or concrete at his option.

M. Concrete Lining

Clean all surfaces against which concrete is to be placed of standing and running water, mud, loose material, oil, debris, frost, and ice. If the surface is absorptive, moisten it thoroughly or otherwise treat it to keep the newly placed concrete from losing moisture.

Construct permanent lining in accordance with the requirements of Section 02320 – Concrete Lining.

Place concrete for lining upper portion of tunnel by mechanical or pneumatic methods through pipes which discharge as nearly as practicable to the highest point of the structure.

Prior to placement of concrete, remove timber blocks or wedges extending within the concrete design line by such means as to not endanger the stability of the surrounding ground.

Fill spaces around posts, ribs, and lagging beyond the limits of the concrete lining, using mortar or grout as best suited to conditions at particular locations.

Fill any enlargement of the tunnel excavation beyond the dimensions shown either with concrete or grouted pre-packing at no expense to the City and subject to the approval of the Engineer.

Force the concrete in to close contact with the lagging and ribs.

After the concrete has attained its design strength, inject grout through the grout nipples, and as specified in Section 02330 in such quantity and at the specified pressure to fill voids.

For sections in which the permanent lining includes steel ribs, comply with the sequence of operations and details shown.

N. Concrete Invert

Place cast-in-place concrete invert to the limits shown on the Contract Drawings in accordance with Section 03300.

O. Installation of Pipe Inside Permanent Tunnel Lining

Install pipe inside tunnel where indicated on the Drawings. Pipe and joint requirements are specified elsewhere in the Contract Documents. Provide bedding and anchorage in accordance with the Drawings. Provide wooden skids or other approved devices which will not obstruct concrete placing as required to eliminate damage to pipe.

P. Access Shaft Construction

Provide for removal and disposal of all materials of whatever nature encountered, placing and maintaining temporary bracing, construction or access shaft, backfill as shown on the drawings, restoration of all disturbed areas, and all appurtenant work necessary to complete the excavation in the shaft.

Construct shafts in accordance with approved working drawings or details shown on the Drawings. Excavation, backfill and grading are specified elsewhere in these specifications as modified herein.

4. Measurement and Payment

A. Rock Tunnel

Rock tunnel will be measured by the linear foot of the tunnel complete in place measured along the tunnel center line from inside face of access shaft. Measurement shall be to the nearest linear foot.

Payment will be made for the quantities measured at the unit price per linear foot for the various types and sizes of tunnel listed in the Bid Schedule.

Payments will include excavation, initial support systems, and final linings.

Payment includes filling of over-excavated areas with concrete or other materials as directed by the Engineer.

B. Access Shafts

Access shafts will be measured for payment by the lump sum for each shaft complete in place. Payment will be made for the quantities measured at the lump sum price listed in the Bid Schedule.

C. Non-Payment Items

The following items will not be measured for payment but will be considered as incidental to the Contract:

Blasting; Control, handling and disposal of water and excavated material; Drilling and grouting; and Excavation and backfill where required.

SECTION 02320

CONCRETE LINING

1. General

A. Description

This section includes proportioning, mixing, transporting, placing, finishing, and curing of all concrete for cast-in-place tunnel final lining and incorporation in the work of reinforcing steel bars, welded wire fabric, and accessories in accordance with the separate specifications for cast-in-place concrete as modified herein.

B. Submittals

Submit working drawings labeled by the City contract number, project name and location, submittal numbers signed and sealed by a Professional Engineer in the State of Maryland showing details of tunnel forms, methods of form construction, erecting, removal, and relocation; including design computation for formwork.

Formwork shall be designed for the loads and lateral pressure outlined in ACI 347 as modified herein and other loads indicated. Forms shall be designed to have sufficient strength to carry the dead weight of the concrete as a liquid in addition to an assumed vertical load of 1,500 pounds per square foot acting normal to the forming.

Submit proposed methods for controlling concrete temperature, consolidation of concrete, and pumping concrete at least 30 days before commencing concrete pours.

Pumping procedure shall describe the equipment to be used, the construction methods, and the concrete mix. Pneumatic pumping will not be permitted.

C. Job Conditions

Maximum slump for concrete at point of placement, prior to being compacted by approved mechanical vibrators shall conform to the following:

- | | |
|--|------------------|
| 1. Footings and tunnel invert | 3 inches maximum |
| 2. Tunnel arch and full circle, tunnel lining (pumped) and concrete fill around carrier pipe | 5 inches maximum |
| 3. All other | 4 inches maximum |

A tolerance of up to one inch above the indicated maximum shall be allowed for individual batches provided that the average for all batches or the most recent ten batches tested, whichever is fewer, does not exceed the maximum limit.

Placing temperature of fresh concrete shall be between 45 degrees Fahrenheit and 90 degrees Fahrenheit.

2. Materials

A. Requirements

Concrete Lining

1. **Portland cement shall conform to ASTM C150, Type I.**
2. **Air Entraining Admixtures – Concrete shall be air entrained to between three and six percent.**
3. **Water Reducing, Retarding and Accelerating Admixtures – Depending upon ambient temperature and job conditions or when directed by the Engineer, water-reducing and retarding, or water-reducing and accelerating admixtures shall be added to Portland cement concrete mixtures. Admixtures shall be compatible with each other.**
4. **Coarse aggregate shall be crushed stone conforming to ASTM C33, gradation #467.**
5. **Fine aggregate shall conform to ASTM C33, and shall consist of washed natural sand or stone sand.**
6. **Concrete Strength – All concrete shall have a 28 day compressive strength of 4,000 psi and shall contain not less than 6.5 bags of cement per cubic yard of concrete.**

3. Execution

A. Requirements

Cast-In-Place Concrete Lining:

Formwork

Forms for tunnel concrete final lining:

Forms for tunnel concrete final lining shall be of steel and shall be constructed in such lengths that each concrete placement can be completed without intervening cold joints. Steel forms are not required for junctions or elbows.

Provide openings for tunnel arch or full circle forms not less than 24 inches by 18 inches along each sidewall and at the crown, as follows:

Openings in the crown spaced at not more than eight feet on centers and located alternately on each side of the tunnel centerline.

Openings in sidewall forms located at mid-height of the tunnel in each sidewall and spaced at not more than eight feet in centers along each sidewall.

If the full circular of cast-in-place tunnel lining is placed in one continuous operation, construct the tunnel form so that at least the bottom 60 degrees of the tunnel invert portion of the form can be loosened or removed.

Preparation for Placing

Control water in the tunnel so that at no time during placement or hardening of the concrete will water wash, mix with, or seep into the unhardened concrete.

All formed and unformed joints inside the neat line of tunnel and shaft concrete final lining shall be treated as construction joints.

Transporting and Conveying Concrete

The methods and equipment used for transporting or conveying concrete from the point of delivery and the time that elapses during transportation or conveyance shall be such as will not cause appreciable segregation of coarse aggregate in the concrete as it is delivered to the work.

Notify the Engineer at least 24 hours in advance of the start of the concrete placing. Perform placing of concrete only in the presence of the Engineer.

General:

Start placement of structural concrete on or next to a construction joint with an oversanded mix with 3/4 inch maximum aggregate, an extra sack of cement per cubic yard and a five inch slump. Place this mix from one to three inches deep on the construction joint.

Pumping shall be in accordance with the procedure submitted by the Contractor. All concrete pumping work shall be in accordance with ACI 301, ACI 304, Chapter 9, and ACI 304, Title No. 68 – 33.

Do not place concrete which has been mixed more than 90 minutes or which has attained initial set.

Tunnel concrete final lining:

At the option of the Contractor, tunnel concrete final lining may be formed and placed for the full circular tunnel section in one continuous operation or the tunnel invert may be cast separately from the remainder of the tunnel section.

Place concrete in tunnel arch or for the full circular section by pumping or other methods approved by the Engineer. After the concrete has built up to the

crown, keep the end of the discharge line buried a minimum of five feet into the concrete during placement.

Construction joints at the ends of concrete placements for concrete final lining and cold joints made necessary by an unavoidable interruption in concrete placement may be formed below springline, informed sloping joints above spring line or entirely unformed sloping joints.

Consolidation:

Consolidate all concrete by the method submitted to and approved by the Engineer.

Consolidate concrete in tunnel concrete final lining by immersion type vibrators and by form vibrators. Rigidly attach form vibrators to the forms and operate at speeds at least 8,000 cpm when vibrating concrete. Operate form vibrators at successive locations closely behind the advancing slope of concrete in the sidewalls and shoulders of the arch. Coordinate the location of form vibrators at the crown, position of the end of the discharge line, operations of vibrators, discharge of concrete, and withdrawal of the discharge line so as to obtain maximum filling of the crown with concrete. Avoid settlement and flow of concrete from the filled crown due to improperly positioned and timed vibration.

Finishing

General:

Test concrete surfaces to determine that surface irregularities are within the limits hereinafter specified.

Abrupt irregularities will be tested by direct measurements. All other irregularities will be measured as the departure from the testing edge of an approved ten foot template held in parallel to, and in contact with, the surface. The template shall consist of a straightedge or the equivalent thereof for curved surfaces.

Unformed Surfaces:

Surface irregularities, for screeded finish measured as described above, shall not exceed 3/8 inch.

Surface irregularities for floated finish shall not exceed 1/4 inch. Tool joints and edges where shown on the plans or directed by the Engineer.

Curing and Protection:

Curing of concrete shall be in accordance with ACI 301 and ACI 308.

Water Curing:

Start water cure immediately upon removal of forms. Keep concrete cured with water for at least 14 days immediately following placement of the concrete or

until covered with fresh concrete. Water curing of concrete may be reduced to six days during the periods when the mean daily temperature in the vicinity of the worksite is less than 40 °F.

Curing Compound:

Curing compounds shall be used only as directed by the Engineer.

Defective Concrete:

When directed by the Engineer, remove and repair defective concrete in accordance with the provision of ACI 201, Chapter 7, at no cost to the City.

Concrete shall be considered defective if concrete cylinders fail to meet specified test requirements, if it is structurally unsound, not water-tight or improperly finished, the Engineer shall have the right to require replacement of the defective portion of the structure. All strengthening or correcting defective portions of concrete is at no cost to the City.

Damaged Work:

Before final acceptance of the Work, repair damage to surfaces, corners of concrete and concrete finish, at no cost to the City.

Damaged places where surface repairs are permitted shall be brought to a smooth, dense, watertight condition to meet specification requirements.

Tolerances for Concrete Construction:

Construct final lining to the line and grade indicated on the Plans so as to allow a minimum concrete cradle thickness of four inches.

Where carrier pipe is not utilized, allow a maximum departure of one inch from established grade and three inches per 100 feet from established alignment.

Place reinforcement so that there will be clear distance of at least two inches between the reinforcement and any anchor bolts or other embedded metal work. Reinforcement is specified in the Section entitled Cast-In-Place Concrete.

4. Measurement and Payment

Measurement and payment for work specified in the Section is included in the cost of Rock Tunneling, Section 02303.

SECTION 02321

SHOTCRETE

1. General

A. Description

This Section includes the testing, production, and application of shotcrete for both initial support and final lining, in accordance with the Contract Documents and ACI 506 as modified herein.

Definition:

Shotcrete is Portland cement concrete applied from a nozzle by compressed air, and containing, if necessary, admixtures to provide quick set, high early strength, and satisfactory adhesion.

B. Quality Assurance

Applicator Qualifications

Employ nozzlemen who have had previous experience in the application of coarse aggregate shotcrete or have worked under the immediate supervision of a foreman or instructor with at least five years of experience. Have each crew demonstrate, to the satisfaction of the Engineer, acceptable proficiency in uniformity of application of shotcrete to vertical and overhead test panels before beginning production work.

Uniformity of Materials

Use the same cement, aggregate and water in the applied production work as that used in approved test areas and test units. Minor adjustment permitted subject to prior approval of the Engineer. Maintain specified strengths.

Properties of Shotcrete

General Requirements:

Develop the shotcrete mix by laboratory tests and field trials as indicated herein at least 90 days prior to actual application of shotcrete to any surface forming a part of the work.

Make laboratory trial mixes with exactly the same ingredients that are proposed for use in the work.

To ascertain capability of ingredients and their optimum proportions, develop a shotcrete mix having the same strength and characteristics as required for actual application.

Proportions:

Proportion shotcrete dry mixes equivalent to those of a concrete mix having between 6.5 and 8.0 bags of cement per cubic yard and a water-cement ratio of 0.04.

C. Submittals

Submit test reports for all tests. The contractor shall provide testing laboratory from the membership of the American Council of Independent Laboratories and as approved by the City. Report all test results without adjustment for type or size of specimen.

Laboratory Testing

Prior to making laboratory tests submit a detailed plan showing methods, materials and proportions to be used in such tests. The Engineer reserves the right to inspect the tests at any time.

Submit results of standard concrete cylinder and accelerating admixture tests demonstrating compliance of the proposed materials with requirements of Field Quality Control as specified herein.

Certificates

Laboratory test reports and mill or manufacturer's certificates with the mix design stating that materials meet the specified requirements.

Field Trial Samples and Reports

On completion of the field trial, submit 36 test specimens of each mix, six from each test panel, that it is proposed to use in the work together with all relevant data which demonstrates conformance to the specifications in all respects. These specimens will be tested by the Engineer to verify conformance with these specifications.

Do not use shotcrete that has not been approved by the Engineer in permanent lining work.

D. Product Delivery, Storage and Handling

Store and handle basic materials in accordance with General Conditions.

E. Job Conditions

Alkali hydroxides and other chemicals contained in shotcrete admixtures are moderately toxic and can cause skin and respiratory irritation unless adequate safety measures are undertaken.

When applying shotcrete containing toxic admixtures, have nozzle men and helpers wear appropriate hoods supplied with filtered air free of toxic or objectionable material.

Have nozzlemen and helpers wear gloves and necessary protective clothing to protect against dermatitis.

2. Materials

A. **Portland Cement shall conform to requirements of ASTM C150, Type I. Type III cement may be used if approved by the Engineer at no additional cost to the City.**

B. **Aggregate shall have the following properties:**

1. **Coarse aggregate**

Coarse aggregate shall be crushed stone conforming to ASTM C33, gradation #467.

2. **Fine Aggregate**

Fine aggregate shall conform to ASTM C33, and shall consist of washed natural sand or stone sand.

3. **Uniformly well graded and not exhibiting extremes of gradation.**

4. **Specific gravity 2.55 minimum.**

5. **The maximum size of the aggregates may be varied subject to the approval of the Engineer, or as directed by the Engineer.**

C. **Water shall meet the pH requirements of AASHTO T26, Method B. Water shall not smell or be discolored. Water shall have a chlorine content less than 500 ppm. If questionable quality, water shall meet the limits of the comparison tests with distilled water in accordance with AASHTO T26.**

D. **Admixtures shall conform with requirements of ASTM C494, Type C, with the following additional requirements:**

Containing no water-soluble chlorides or materials corrosive to steel nor entailing other detrimental effects such as cracking and spalling.

Documented to have a history of demonstrable satisfactory performance in a similar application.

3. Execution

A. **Field Quality Control**

Standard Concrete Cylinder Testing

Choose materials and proportions so that three six inch by 12 inch cylinders made with no additive and with a water-cement ratio of 0.4 will achieve an

average minimum strength at 28 days of 7000 psi. Make cylinders in accordance with ASTM C192 and test in accordance with ASTM C39.

Make a minimum of three cylinders for each combination of materials proposed for use on the job.

Accelerating Admixture

Use an approved accelerating admixture to develop quick set and high early strength as follows:

| | |
|--------------------------------|---------------------------|
| Time of initial setting | 3 minutes maximum |
| Time for final setting | 12 minutes maximum |

Determine time of setting in accordance with ASTM C266 modified as follows:

1. Add the accelerator to 50 grams of cement in the preparation of the paste together with water to produce a water-cement ratio of 0.40, in varying percentages expected to be used in actual shotcrete application.
2. Use the minimum possible time interval to attain proper mixing without disturbing the initial set of the paste.
3. Additional modifications as necessary to accommodate rapid set accelerators, as approved by the Engineer.

Field Trial

After completion of laboratory tests and their approval, make field trials using selected mixes utilizing materials successfully tested as specified herein to demonstrate capability of equipment, workmanship, and material under field conditions at least 60 days prior to actual application of shotcrete to any surface forming part of the work.

Make field application of each mix selected for field trial on at least three horizontal overhead and three vertical test panels to simulate construction conditions.

Cast test panels on forms measuring not less than 20 inches by 20 inches by four inches.

Cure test panels in accordance with ASTM C31.

Two days after casting, obtain a minimum of six three-inch diameter cores from each panel. Cut each core to a length equal to its diameter.

Average three cores from each panel to comprise one test.

Obtain, prepare and test the specimens in accordance with ASTM C42 as herein modified. Do not soak test specimens. Make no L/D corrections in reporting results.

Perform field trial work and testing in the presence of a representative of the Engineer.

Achieve strengths as follows:

**Average strength of six tests at three days: 3,000 psi minimum.
Average strength of six tests at 28 days: 5,540 psi minimum.**

Shotcrete Strength Determined by Testing During Construction

- 1. Average strength of three cores from one area: 4,670-psi minimum when tested at 28 days.**
- 2. Minimum strength of any one core: 4,120 psi at 28 days.**
- 3. Minimum strength of forces from special mix for use in wet areas: 3,270 psi at 28 days.**

Testing During Construction

Furnish three-inch diameter standard core test specimens at the rate of three for each 50 cubic yards of material. Furnish specimens, which have a minimum length equal to the diameter.

Take cores from completed work at locations and on the date directed by the Engineer.

Test cores will be tested by the Engineer in accordance with ASTM C42, as herein modified for the field trial specimens.

Cure specimens in accordance with ASTM C31.

Furnish specimens at no cost to the City.

At the discretion of the Engineer test specimens may be called for at the reduced rate of 3 for each 100 cubic yards of material after application of the first 500 cubic yards of shotcrete.

Additional specimens may be required at any time by the Engineer. Should additional specimens show acceptable strength, Contractor will be reimbursed for the additional cost, if any. Should these specimens fail, the expenses of furnishing additional specimens shall be deemed incidental to the work and cost thereof shall be borne by the Contractor.

The Engineer may require strengthening or correcting of understrength portions of the shotcrete lining. All costs incurred for said strengthening or correcting of the defective portion of the structure shall be at no cost to the City.

Plug voids caused by the coring operation by use of material equal to the shotcrete in-place and workmanship to insure continuity of the lining as to water tightness, strength, and appearance.

B. Proportioning and Mixing

Proportion aggregate and cement on a weight or volumetric basis by a suitable batching plant, conforming to applicable provisions for cast-in-place concrete contained in a separate section of the specifications.

For dry mix process, maintain the moisture content of the combined aggregate at time of mixing with cement in the range of three to six percent of the oven-dry weight of the aggregate.

Use mixed material within 60 minutes after adding cement; or waste without payment.

Additive accurately proportioned and mixed thoroughly with other ingredients.

C. Shotcrete Application

Clean off loose material, mud, and other foreign matter from surface, whether new or previously shotcreted, that are to receive shotcrete.

Maintain the surface moist from the time cleaning is completed until shotcrete is applied.

Hold the nozzle at a predetermined distance and position so that the stream of flowing material is applied as nearly as possible at right angles to the surface to be covered.

Hold nozzle in steady motion to build up the required thickness of layer.

Acceptable shotcrete will consist of a dense and uniform concrete without rebound inclusions, segregation, or discernible weakness of bond between layers.

Apply shotcrete with a uniform consistency in order to maximize binding, cohesion, and density, minimize rebound and segregation, and prevent sagging of applied shotcrete.

D. Sequence of Operations

Apply shotcrete lining in two or more layers.

Apply the first layer to the surface of the excavation exposed by blasting starting not later than one hour after blasting.

Install rock bolts and direct support and reinforcement, where used, after application of the first layer of shotcrete and before next layer is applied.

Apply the total thickness of shotcrete to all rock surfaces within the period specified.

Remove all laitance, loose material and rebound and sound the surface layer with a hammer for voids, rebound or aggregate pockets and unbounded areas.

Remove and replace portions deemed defective by the Engineer at no additional cost to the City.

Cure the final shotcrete layer for seven days in accordance with ACI 301 and ACI 308. Water curing shall start immediately upon removal of forms and continue for a minimum of fourteen days thereafter or until covered with fresh concrete. Water curing may be reduced when the mean daily temperature is below 40°F. Curing compounds may only be used as directed by the City.

E. Control of Water

Control water flows and seepage in such a manner that detrimental effects are completely and permanently eliminated. Water may be drained by pipes, chases, or other appropriate methods approved by the Engineer.

Where the presence of excessive water conditions precludes the use of regular mixes for the first layer, with approval of the Engineer, use a previously approved mix with high additive factor to seal off the area.

F. Defective Shotcrete

Shotcrete which lacks uniformity, exhibits segregation, low strength, honeycombing, lamination, shows cracking or lacks water-tightness will be regarded as defective. The Engineer reserves the right to order removal of defective shotcrete and its replacement with acceptable shotcrete without additional cost to the City. Any remedial measures ordered by the Engineer to correct defective shotcrete will also be at no additional cost to the City.

4. Measurement and Payment

A. Shotcrete

Work described in this section will not be measured separately for payment but payment will be included in the cost of work for Rock Tunneling, Section 02303.

SECTION 02330

DRILLING AND GROUTING

1. General

A. Description

This section includes drilling feeler holes, alignment holes, drainage and other holes and furnishing materials for grout and injecting grout and patching the finished holes in accordance with the Contract Documents.

Definitions:

Pressure grouting includes consolidation grouting in certain areas of the work to control water flows and to consolidate ground, and contact grouting to fill voids between concrete lining and ground.

B. Submittals

Submit details of grout mix composition and grouting plan for approval at least 30 days prior to grouting

Submit log of all drill holes including description of all materials of whatever character encountered in the drilling and their locations in the holes; the location of special features such as mud seams, open cracks, soft or broken ground; points where abnormal loss or gain of drill water has occurred; groundwater levels; or any other items of interest in connection with the grouting or other drilling.

Submit quantities, mix, and pressure used at each location.

C. Field Conditions

Assist and cooperate with the Engineer in keeping records of grouting operations including time of each change in the grouting pressures, rate of pumping, amount of cement for each change in water cement ratio, and such other data as may be deemed necessary.

Notify the Engineer at least one week in advance of the date it is intended to start contact or consolidation grouting operations.

2. Materials

A. Grout

Grout shall be a mixture of cement and water or cement, sand, and water, of the proper consistency to suit the characteristics of the hole being grouted or the type of grouting being performed.

- 1. Water for mixing grout shall meet the pH requirements of AASHTO T26, Method B. Water shall not smell or be discolored. Water shall have a chlorine content less than 500 ppm. If of questionable quality, water shall meet the limits of the comparison tests with distilled water in accordance with AASHTO T26.**
- 2. Cement shall be ASTM C150, Type II.**
- 3. Sand shall conform to requirements of ASTM C33 for fine aggregate modified so that 100 percent passes U.S. Standard sieve No. 16.**

Grade as follows for contact grouting:

| <u>Sieve Size</u> <u>U.S. Standard</u> | <u>Percent Passing</u> |
|---|------------------------|
| 8 | 100 |
| 16 | 95 – 100 |
| 30 | 65 – 90 |
| 50 | 20 – 60 |
| 100 | 5 – 15 |
| 200 | 0 – 15 |

Grout pipe and Fittings: Pipe and fittings shall conform to ASTM A120, Standard Weight Schedule 40, Black.

Admixtures: Admixtures for fluidity or retarding setup shall conform to ASTM C494, Type A, D, or E and shall be approved by the Engineer prior to its use in the grout. Admixtures shall be compatible with each other.

B. Equipment

Furnish accurately calibrated, high precision, pressure gauge for periodic checking accuracy of all gauges used in grouting.

3. Execution

A. General

The amount of drilling and consolidation grouting to be performed will depend upon the nature of the materials encountered in the tunnels as the work

proceeds. Perform drilling and grouting at such locations, at such times, and in such quantities as shown on the contract drawings or as directed or approved by the Engineer.

Grouting mixes, pressures, the pumping rate and the sequence in which the holes are drilled and grouted will be determined in the field and shall be as approved or directed by the Engineer.

B. Equipment

For feeler, grout, and drain holes use either rotary or percussion drilling equipment.

For pumping grout, use an approved pump which is capable of developing a uniform pressure of 100 psi at the grout hole connection and hoses with a minimum 1-1/2 inch inside diameter. The arrangement of the grouting equipment shall provide for continuous circulation of grout in the system and shall permit accurate pressure control.

Keep equipment and lines clean by the constant circulation of grout and by periodic flushing. The grouting equipment shall be such that flushing can be accomplished with the grout intake valves closed, the water supply valve open and the grout pump running at full speed.

Use a mixer of horizontal shaft paddle or colloidal pump type with a minimum capacity of 20 cubic feet and with an accurate meter, reading in cubic feet to the nearest one tenth of a cubic foot for measuring the amount of mixing water added to the grout.

Provide two pressure gauges, one at the grout pump and the other on the manifold hookup at the collar of the hole being grouted. Pressure gauges shall have a range to 1-1/2 times maximum specified pressures and accuracy of one psi. Suitable stop valves shall be provided at the collar of the hole for use in maintaining pressure as required until the grout has set.

Maintain grouting equipment in satisfactory operating condition throughout the course of the work in order to ensure continuous and efficient performance during grouting operations.

C. Drainage Holes

Use plastic pipes of polyvinyl chloride for weep holes where shown with fittings, fastened with adhesive or threads, except that the cleanout plug shall be threaded.

D. Grout Holes

Drill grout holes in rock or lining as shown or as directed or approved by the Engineer. Holes for air release shall be located at high points of overbreak in tunnel excavation. Holes shall be formed by embedding pipe in the concrete during placing of the concrete final lining or by drilling through the concrete final lining. Grout holes drilled in the concrete final lining shall be two inches in diameter or, if pipe casing is to be set, shall be of sufficient diameter to

permit the caulking or grouting of short lengths of two inch diameter pipe into the hole.

Avoid cutting embedded steel. If steel is encountered abandon and patch the hole.

Clean obstructed holes for entire depth prior to grouting.

Thoroughly wash grout holes immediately before starting pressure grouting.

E. Preparation for Grouting

Immediately before grouting, wash grout holes and intersecting rock seams and crevices with water applied at the same pressure with which the grout is to be applied.

Continue washing as long as there is evidence of washable materials being removed.

F. Grouting, General

Perform grouting in accordance with requirements of ACI 506 as modified herein.

Pipes and Fittings:

Place pipes to be embedded in tunnel lining for consolidation or contact grouting connections and air vents as shown or directed by the Engineer.

Set the inner end of pipes not less than two inches back from the finished inside surface and provide recesses there from to the surfaces of the lining. Fill the recesses with concrete or mortar after grouting operations have been completed.

Set the grout pipes so that grout can flow freely to the voids behind the lining.

Hold pipes to be embedded firmly in position and protect from damage while concrete is being placed. Provide and attach caps or other devices to the ends of the pipe to prevent entry of concrete or other foreign materials prior to grouting, and to facilitate location of the grout pipe after forms are removed.

Avoid clogging or obstructing the pipes before grout hookups are made. Clean pipes that become clogged or obstructed.

Connections:

Make connections so as to prevent leakage.

Remove plugs on ends of grout holes or permit escape of air and water and the filling of spaces with grout.

Provide straightway cock or valve at each connection.

Grouting Operations:

Perform grouting operations in the presence of the Engineer.

Use grout of a consistency to suit the characteristics of the hole being grouted or the type of grouting being performed.

Use pressure at the hole as directed or approved by the Engineer. However, in no case shall the pressure exceed a value of 50 psi.

Consider the grouting of a hole complete when the hole refuses grout at 90 percent of the highest pressure directed.

Upon completion of the grouting at each connection, close the valve and leave it in place until grout has set.

After the grout has set, remove valves and fitting and metal connection to a depth of at least 1-1/2 inches from the face of the concrete.

Fill grout holes with thick grout or dry pack at the completion of the grouting operations to give a smooth finished surface.

Take care not to block drains or drain line during grouting operations. Clean drains after each grouting operation.

G. Consolidation Grouting

Perform consolidation grouting where shown, or as directed or approved by the Engineer.

For consolidation grouting performed after contact grouting, allow a period of at least seven days to elapse between the completion of the contact grouting and the beginning of the consolidation grouting.

Perform consolidation grouting within a radius of 50 feet of cast-in-place concrete tunnel lining only when the lining is more than 14 days old.

H. Contact Grouting

Perform contact grouting through holes drilled or placed in tunnel lining where shown or as approved or directed by the Engineer.

If not shown or directed otherwise, locate grout holes in the tunnel crown at ten feet on center alternately 15 degrees each side of the tunnel centerline.

Provide vent pipes to suit the conditions encountered.

Perform contact grouting behind concrete liner only when concrete is more than 14 days old.

Use a maximum pressure for contact grouting as directed by the Engineer, but in no case shall the pressure exceed 25 psi.

Continue grouting until a clear grout stream emerges from the vent pipe.

I. **Feeler or Exploratory Holes**

Drill feeler or exploratory holes as required determining the type, nature, and condition of the materials to be excavated.

Obtain the approval of the Engineer for the location, direction, length, and number of holes.

When feeler or exploratory holes are being drilled, suspend or modify other operations as may be necessary to permit such drilling. Drill holes only in the presence of the Engineer.

4. **Measurement and Payment**

A. **Drilling and Grouting**

Work described in this section will not be measured for payment but the cost thereof shall be considered incidental to the Contract.

SECTION 02340

ROCK REINFORCEMENT AND SUPPORT

1. General

A. Description

This section includes furnishing, installing, and testing rock bolts and accessories, welded wire fabric, miscellaneous steel and steel ribs, blocking and lagging and accessories for both initial and permanent support of tunnels in rock in accordance with the Contract Documents.

B. Submittals

Rock Bolts:

Thirty days prior to beginning work at this time, submit shop drawings labeled by City contract number, project name and location, submittal numbers, shop drawing title, revision number, and date of drawing and all revisions showing the following information:

- 1. Locations, installation procedures and layouts of rock bolt installations.**
- 2. The spacing, type, size, and length of rock bolts, together with the type of bolt accessories and surface covering and the time and distance from face for installation.**
- 3. Certificates stating that samples for testing are from normal stock, certified mill reports of the bolts, and certified test reports for grouting materials.**
- 4. Manufacturer, types and certificates for resin anchor material.**

Steel Ribs:

Sixty days prior to start of work under this item, submit working drawings in accordance with Section 01102 indicating in detail the method proposed to be used for steel support in tunnel excavations.

Submittals shall include:

- 1. Sizes**
- 2. Details and arrangement of members**
- 3. Method of assembly**
- 4. Lists of materials**

5. Design calculations

C. Job Conditions

Rock Bolts:

At the beginning of rock bolt installation in tunnel, install a minimum of 5 rock bolts in the face or other ground to be excavated, using equipment, materials, and procedures to be used in production rock bolting. Engineer will select a minimum of 3 rock bolts to be removed by Contractor either by over-coring or by drilling surrounding holes and blasting with a light charge.

Removed bolts shall be examined to ensure that all resin is mixed, that all resin cartridge material is properly shredded, and that resin bonds to or fills the annular space between the ground and the rock bolt.

Prior to removal of rock bolts for examination, a minimum of 2 rock bolts shall be pull tested to 90% of the guaranteed yield strength of the bolt.

Rock bolt shall show no indication of movement when pull tested.

Steel Ribs:

Design steel ribs and lagging or blocking to provide sufficient capacity to support the ground safely and maintain the shape of the tunnel without encroaching beyond the tolerances stated herein until permanent lining is complete and ready to accept loading.

2. Materials

A. Requirements

Rock Bolts:

Obtain rock bolts and resin anchor material from an established manufacturer who has regularly produced these products for at least five years.

Use only fully encapsulated resin anchor rock bolts.

Rock bolts shall be resin anchor type and conform to ASTM ES3. Steel shall conform to ASTM A615, Grade 60. Rock bolts shall be round deformed concrete reinforcing bar. All resin anchor rock bolts shall have at least 5-1/2 inches of thread on the outer end. Each bolt shall be furnished with one steel bearing plate, hardened steel flat and spherical or beveled washers, and one nut, welded wire fabric anchor plates and extra nuts as required for installation of the rock bolts, welded wire fabric and accessory steel.

The threads of rock bolts and the entire surface of nuts and washers shall be coated at the factory with grease containing a rust inhibiting compound. Excess grease shall be removed before installation. Bolts shall not be coated with oil, grease, or rust inhibiting compounds except on the threaded outer end.

The resin anchor shall be capable of developing the guaranteed minimum yield strength of the bolt. The resin anchor shall be a standard product of a company regularly engaged in the manufacture of this type of product. The resin shall be contained in cartridges of approved diameter and length. The cartridge shall have a casing constructed of saturated polyester providing an optimum resistance to moisture with a high frangibility for complete mixing during installation. Resin shall not be used after the expiration date stated by the Manufacturer.

The cartridge shall contain two distinct factions of unsaturated polyester resin and catalyst without an intervening mechanical membrane. The resin shall be high-strength polyester, highly filled with non-reactive inorganic filler. The system of resin encapsulation shall permit mixing of resin and catalyst in the bolt hole by rotation of the rock bolt. The mixed resin shall be thixotropic and of such viscosity that it will not flow from the hole before adequate gel and cure is achieved. The compressive strength of the mixed and cured resin shall be 17,000 psi when tested in accordance with ASTM C39. Inspect all cartridges prior to insertion to see that the polyester resin compounds have not hardened and meet the above requirements. Cartridges shall be stored so as to ensure maximum protection until their use. Provide facilities to prevent prolonged exposure to elevated temperatures (above 75° F) during storage. Nuts shall be hexagon head, conforming to the requirements of ASTM A325, Grade B. Bevel washers shall be steel or malleable iron. Hardened steel washers shall conform to the requirements of ASTM Designation A325.

Provide resin cartridges with different setting times for rock bolts which are to be tensioned.

Accessory steel shall consist of rock bolt mats, channel strapping, mine roof ties, mine roof channels, or similar members. Accessory steel items shall be the product of an established manufacturer and shall meet the approval of the Engineer before being used in the work.

Welded wire fabric for rock reinforcement shall be of the size and spacing shown on the plans or as approved by the Engineer, shall conform to the requirements of ASTM A185, Style 4 x 4 – W2.0 x W2.9, and need not be galvanized.

Steel Ribs:

Structural steel shall conform to requirements of Section 05120 as modified herein. Structural steel shall conform to requirements of ASTM A36.

Steel Rib Bending Tolerance:

Conforming to true template: +/- 3/8 inch between the plates and +/- 1/8 inch in three foot gauge depth.

Bending curvature uniform.

After Bending:

Outer flange will be permitted to drop 1/8-inch maximum toward the inner flange for radii of bend less than 14 times the rib depth.

Buckling of the web for a distance of 1/2 inch the rib depth from either end will be permitted with deviation from the flat no greater than +/- 1/8 inch for radii of bend equal to 14 times the rib depth or greater.

Buckling of the web for a distance equal to the depth of the rib from either end will be permitted with deviation from the flat no greater than +/- 3/16 inch for radii of bend less than 14 times the rib depth.

Rib depth at the web no smaller than the theoretical depth minus 1/4 inch.

Bolts shall conform to requirements of ASTM 325.

Timber for blocking, lagging, foot blocks, and cribbing shall be sound, well seasoned timber of rectangular cross section, Douglas Fir standard grade or equal.

3. Execution

A. Rock Bolts

Installation:

For underground excavation in rock on which bolts are used, install the rock bolts as soon as possible but no later than five hours after blasting and prior to the next shot. Install the first 50 rock bolts under the direct supervision of a qualified representative of the rock bolt manufacturer and in the presence of Engineer.

Install resin anchors rock bolts in accordance with manufacturer's recommendations.

After each shot, examine the surface and confirm that the rock bolt pattern to be installed will be adequate. Provide rock reinforcement that is adequate at all times to ensure the safety of personnel and the construction operations.

Drill holes in the rock to the required depth and diameter in accordance with the resin manufacturer's recommendations taking into account the rock bolt size and the resin cartridge size. The diameter of the bolt holes shall be uniform for the entire length of the hole. Clean holes of drill cuttings, sludge and debris before installing resin cartridges.

Avoid damaging the threads on the projecting end of the bolt during installation.

Remove protective grease from threads and nuts.

Clean threads so as to be free of rust, burrs, and foreign matter. Apply lubricant to the threads. Use lubricant between the washer and the nut.

Insert the rock bolt in the bolt hole until it contacts the first cartridge. At this point, rotate the bolt between 120 and 500 rpm and insert the bolt at a penetration rate of approximately 2” – 4” per second. When the bolt reaches the back of the hole, continue rotation for an additional 10 – 15 seconds. The Contractor shall promptly clean up, to the satisfaction of the Engineer, and excess resin which flows from the hole.

Set the bearing surface of the nut perpendicular to the bolt, by the use of bevel washers where required between the bearing plate and steel washer.

Maintain bolt in place until resin has set.

Where cartridges with different setting times are required, install faster setting cartridge in back of bolt hole to hold bolt for tensioning and simultaneously install slower set cartridges as required to complete grouting of the bolt. Complete tensioning after faster setting cartridges have set but before slower cartridges have set.

Tension Testing of Installed Rock Bolts:

When directed by the Engineer, perform a tension test of installed bolts in accordance with the following schedule. Test one bolt per fifty of the first 400 installed and one bolt per hundred of the remaining bolts installed. Tension test by a direct pull, using approved jacks.

Perform testing to verify that the bolt can sustain the specified tension.

Rock bolts will be tested to at least 80 percent of the minimum specified yield strength.

Replace a tested bolt that fails or pulls out with another bolt that meets these testing requirements.

Perform further testing, up to a maximum of five rock bolts in the vicinity of the failed bolt as directed by the Engineer. Replace any such bolt that fails or pulls out as directed.

For test purposes, the bolt will be considered to have failed if any outward movement of the bolt anchorage occurs and continues to occur at a sustained loading below the required tension.

Rock Surface Reinforcement:

Install where shown, as conditions at the site require and where directed or approved by the Engineer, rock surface reinforcement consisting of wire fabric, miscellaneous steel or a combination of both. Rock conditions which may require surface reinforcement include places where the rock is excessively jointed, fractured, or has a tendency to spall.

For installation of surface reinforcement and rock bolts simultaneously, place the reinforcing materials over the rock bolts between the rock surface and the steel bearing plate, and tension the bolt to draw the reinforcing materials up

tightly to the rock surface. Where wire fabric is used, provide overlaps of 1-1/2 times the width of wire fabric at joints.

Where surface covering or reinforcement is placed after installation of expansion shell anchor rock bolts, attach the materials to the previously installed bolts by the use of an additional steel plate and nut, or by welding or by supporting by additional rock bolts.

Firmly secure surface covering or reinforcement so that it follows closely the approximate contour of the rock.

Structural Steel Support:

Install structural steel supports true to the required lines and grades, blocked, braced, and wedged against the rock surface or against any initial layer of shotcrete placed on the rock surface. Supports placed improperly or damaged due to any cause whatsoever shall be repaired or replaced by the Contractor at no cost to the City.

Install supports as soon as possible after any initial layer of shotcrete is placed or as soon as possible after exposing the rock by excavation and as close to the headings as the work will permit.

Locate joints to facilitate steel rib installation as needed and approved by the Engineer.

Block and wedge steel tunnel ribs securely against the ground surface. Secure steel tunnel ribs against longitudinal movement or distortion by steel flanges of the steel tunnel ribs. The amount of blocking and lagging used shall not exceed the practical minimum that is necessary to safely support the ground. Provide sufficient lagging to protect against spalls and to hold broken rock. Provide support at the base of the horseshoe shaped steel tunnel ribs as required or as shown on the Contract Drawings and install invert struts as necessary.

Place lagging and blocking in the form of open cribbing and arrange to permit the ready flow of concrete through and around the lagging and blocking so that the concrete final lining will be in contact with at least one-half the excavated surface bounded by the centerline of adjacent steel supports and any two longitudinal lines five feet apart.

Prior to concrete placement, remove all lagging, blocking and struts between ribs from inside the neat line. Remove lagging and blocking installed outside the neat line but not necessary for direct support of excavated surfaces during the time of concrete placement.

4. Measurement and Payment

A. Rock and Bolts

Permanent Support:

Rock bolts, miscellaneous steel and wire fabric when installed as permanent support as shown on the Contract Drawings will not be measured separately for payment, but payment will be included in the cost of work specified in Rock Tunneling, Section 02303.

Discretionary Support:

Rock bolts, installed, as discretionary support shall be at no additional cost to the City.

B. Steel Ribs

Permanent Support:

Steel ribs, bolts, blocking and lagging, spacers, concrete for footings and all other accessories when installed as permanent support as shown on the Contract Drawings will not be measured separately for payment, but payment will be included in the cost of Rock Tunneling.

Discretionary Support:

Steel ribs installed as discretionary support will be at no additional cost to the City.

SECTION 02500

ROADWAY PAVEMENT

1. General

A. Description

This section includes removing the replacing paving, including driveways, within the limits indicated. This section also includes new paving and driveways where indicated, including preparation of subgrade and provision of all paving courses as required, in accordance with Contract Documents and as outlined herein.

B. Submittals

Submittals shall be as set forth in the project permits and as required by the governing jurisdiction. For temporary paving before placing pavement, submit asphalt tickets stating type of mix, date mixed and gradation of mineral aggregate.

2. Materials

A. Concrete

Concrete shall meet the jurisdictional requirements specified below, as modified herein.

Contractor may use high early strength Portland cement conforming to ASTM C150, Type II. If high early strength cement is utilized, the use of calcium chloride will be permitted at the rate of one or two percent by weight of cement when temperature is below 40 degrees Fahrenheit.

B. All other materials for permanent pavement placement or replacement shall meet the following jurisdictional requirements:

Work on City roads: Maryland State Highway Administration Specifications, October 1993 and detailed herein. Asphalt mixes as shown on City Details shall be a State Highway Administration approved mix design, from a State Highway Administration approved asphalt plant. Surface asphalt mix must be a virgin asphalt mix containing no recycled asphalt paving (RAP). Base and binder asphalt mixes may contain recycled asphalt paving (RAP) to the extent allowed by Maryland State Highway Administration approved mix design.

C. Temporary Pavement Replacement

The use of temporary pavement shall be as approved by the City and limited to cold weather conditions when permanent pavement is not available. Asphalt

shall be MC250 or MC800 meeting requirements in the applicable Table of Specifications for Paving and Industrial Asphalts of the Asphalt Institute.

Cold applied asphalt may be substituted in cold weather when hot asphalt is not available after gaining permission from the City.

Mineral aggregate shall be crushed stone, crushed or uncrushed gravel, slag, sand, stone or slab screenings, mineral dust, or a combination of any of these materials meeting the following graduations:

SIEVE SIZE

| | |
|----------|----------|
| 1 inch | --- |
| 3/4 inch | 100 |
| 1/2 inch | 90 – 100 |
| 3/8 inch | --- |
| No. 4 | 45 – 70 |
| No. 8 | 25 – 50 |
| No. 50 | 5 – 20 |
| No. 200 | 2 – 9 |

Preparation of Mixture: Course and fine aggregate shall be fed into the plant in the proportions required to provide a total aggregate conforming with the grading specified. The aggregate shall be free from visible moisture at the time of mixing. The asphalt shall be applied at the rate and at the temperature specified by the Engineer to produce a final mixture containing from 4 to 6 percent liquid asphalt by weight of total mix. The mineral aggregate and the asphalt shall be mixed thoroughly until all aggregate particles are completely coated.

Stockpiling: The finished mixture shall be stockpiled on a platform or other approved level storage space. Maximum allowable time from date of mix to arrival at the site shall be one month.

3. Execution

A. General

Construction of new roads and repaving shall be as set forth in the project permits and shall meet all requirements of Maryland State Highway Specifications, October 1993 or as revised herein.

A pre-paving meeting must be scheduled by the Contractor and held at least two weeks prior to paving. The Contractor must notify paving inspector and confirm (by phone or fax) 24 hours minimum in advance of placing asphalt.

B. Removal of Existing Pavement

Cut saw or chisel existing bituminous pavement in advance of trenching to neat lines as shown on the appropriate jurisdictional standard detail, utilizing the City standard trench widths. Remove paving before excavating trench.

Saw-cut existing cement concrete pavement to a minimum depth of two inches. Remove transfer devices where they occur.

C. Preparation for Permanent Paving

Compact backfill as specified in Section 02200 of these specification and provide subgrade and subbase as set forth in jurisdictional requirements.

D. Temporary Pavement

Provide temporary or permanent pavement immediately upon completion of backfill, as directed by the Engineer.

Temporary roadway pavement shall be cold mix as specified hereinabove, minimum three inches (3") thick, except where otherwise required by the contract permits. Addition of deleterious material at the site is prohibited.

For repairs in State roads, provide temporary patch for a minimum of ten (10) days and a maximum of 21 days.

Temporary driveway pavement shall be MSHA SRC gradation CR-6 crusher run stone, minimum six inches (6") thick.

E. Placement of Permanent Pavement

Paving shall be placed to the phasing limits on the approved plans in its entirety. No deviation from the paving plan within a given phase will be permitted without prior approval.

Extent shall be as shown on jurisdictional standard details and on the plans. If pavement has been undermined or disturbed in any way by the Contractor's operations, increase extent of repaving so that the new pavement and base extends at least 18 inches over undisturbed soil.

- Bituminous Pavement Placement/ Replacement: Cover all cut surfaces which are to receive bituminous concrete patch with tack coat, applied under pressure at the rate of 0.01 to 0.05 gallons per square yard of area. Provide tack coat between each new layer of bituminous concrete as needed at the rate of 0.01 to 0.05 gallons per square yard of area. Provide seal coats as specified in jurisdictional requirements. Minimum temperature requirements for air and surface:**

| | | |
|-----------------------|--------------------------------|---|
| Base | 32 degrees and rising | |
| 1-1/2" Binder | 40 degrees and rising * | |
| 1-1/2" Surface | 50 degrees and rising * | Final surface to be placed as follows: |

Final surface can be placed after street is “built out”, but not until such time as construction access through street to be topped is no longer needed, and/or as directed by the Engineer.

* Allow for wind chill factor.

2. Concrete Pavement Replacement: Replace load transfer devices where removed. Place concrete pavement as specified in jurisdictional requirements. Place expansion joints at 40 feet on center maximum or space to match existing joints, whichever is less.
3. Driveway Replacement: Unless otherwise indicated, provide driveway replacement in accordance with Maryland State Highway Administration Specifications and Standard Details.

F. Adjustment of Manholes/ Water Valves, Etc. to Grade

1. Manholes: To be set flush with final paving grade (final inch) and paved around (temporary) with hot mix SF/ SC to prevent damage from occurring to manholes during snow removal.

Manholes – Optional Method: (At the discretion of the developer) Set manholes one inch below proposed finished grade, flush with the surface of 2 inch binder course. At the time final inch of surface is laid, install one inch manhole risers as supplied by Andrews Metal Products, Inc. Type 1, fitted with allen head set screw-locking bolts or approved equal.

2. Valves: Set valve boxes one inch below proposed finished grade, flush with the surface of 2 inch binder course. At the time the final inch of surface is laid, install one-inch valve box risers as supplied by General Engineering, Inc. or approved equal.

4. Measurement and Payment

A. Pavement Replacement at Utility Trenches

Removing existing pavement over utility facilities and constructing new replacement during restoration will be measured for payment by the square yard of area based on the appropriate jurisdictional detail utilizing City standard trench widths, measured along the center line of the trench.

Payment will be made for the quantity measured at the unit price per square yard listed on the Bid Schedule.

B. Other Pavement Replacement

Removing existing driveways and pavement in areas other than over utility facilities as described above and constructing new replacements during

restoration will not be measured for payment but the cost thereof will be considered as incidental to the Contract.

C. Pavement and Driveways in New Areas

Constructing new pavement and driveways where indicated will be measured and paid for as set forth in Special Provisions.

D. Non-Payment Items

The following items of work will not be measured for payment but the costs thereof will be considered as incidental to the Contract.

- 1. Preparation of subgrade.**
- 2. Disposal of removed pavement.**
- 3. Replacement and restoration of pavement outside the limits of payment set forth herein which have been disturbed and damaged by the Contractor's operations.**
- 4. Removal and replacement of driveways at utility trenches.**
- 5. Temporary pavement.**

SECTION 02515

BRICK SIDEWALK

1. General

Brick sidewalk shall be constructed in accordance with the Specification, Standard Details and as directed by the Engineer.

The concrete base shall be constructed in accordance with Section 03300 of these specifications and as directed by the Engineer. After the concrete base has reached the required strength, the Contractor shall place the one (1) inch sand bedding course. Before the bedding course is placed the subgrade shall be sprinkled lightly with water. Bricks shall then be placed on the bedding course in a "Running Bond" pattern as shown in the Plans. Upon completion, the bricks shall be rolled with a 600 lb. hand roller to bring all bricks to grade and bed the bricks in the bedding course. The surface of the bricks will be cleaned to their original finish. The sidewalk shall be kept closed to traffic for three (3) days.

Bricks shall be "Plain Wirecut Red Paving Bricks" 3-5/8" x 2-1/4" x 8" by Glen Gery No. 2134. Bricks can be obtained from the flowing source of supply, or an approved equal may be substituted.

Pen Mar Co., Inc.
Baltimore, Maryland
Phone No. (301)-523-5400

All bricks shall conform to the requirements of ASTM C-7, omitting the rattler test.

2. Measurement and Payment

Brick pavement as specified herein will be paid for at the contract unit price bid for "Plain Wirecut Red Paving Brick, and 1" Sand Bedding Course", which price will include all bricks, sand, forming, cutting and cleaning of bricks and all labor, equipment and incidentals required to satisfactorily complete the item.

The concrete base will be paid for at the contract unit price for "3" Plain Cement Concrete sidewalk, mix #2, complete in place.

SECTION 02525

CURB, CURB AND GUTTER, AND SIDEWALK

1. General

A. Description

This section includes removing and replacing concrete curb, curb and gutter and sidewalks and providing new curb, curb and gutter and sidewalks, within the limits indicated, including preparation of subgrade and providing base courses as required in accordance with the Contract Documents.

B. Submittals

Submittals shall be as set forth in the project permits and as required by the governing jurisdiction.

2. Materials and Construction

A. Jurisdictional Requirements

Materials and construction shall meet the following jurisdictional requirements, unless otherwise indicated:

1. City facilities; **City of Frederick Specifications and Standard Details.**
2. State facilities; **Maryland State Highway Administration Specifications and Standard Details.**

B. Preparation

1. **Preparation of subgrade shall meet jurisdictional requirements stated above.**
2. **Provide base for pavement where required as specified elsewhere in these specifications.**
3. **Compaction shall meet requirements specified elsewhere in these specifications.**

C. Temporary Facilities

Unless otherwise indicated, provide temporary facilities where so directed by Engineer.

D. Formwork

Forms shall be steel forms with the exception of approved flexible forms for radii formation.

E. Concrete

Concrete to be MSHA Class 2, air entrained. Concrete shall be a State Highway Administration approved mix design, from a State Highway Administration approved batch plant.

F. Replacement

Joint spacing shall match existing contiguous work.

G. Cold Weather Concrete

Requirements for protection of concrete in cold weather conditions shall be as per American Concrete Institutes Section 306.

H. Slip Form Method for Curb and Gutter to Comply with State Highway Administration Specifications per Section 806.03.03.

A sample run (minimum 100 LF) will be required to assure compliance with the Details and Specifications.

3. Measurement and Payment

A. Curb, Curb and Gutter and Sidewalk Replacement

Removing existing concrete curb, curb and gutter and sidewalk constructing new replacements during restoration will not be measured for payment but will be considered as incidental to the Contract.

B. Curb, Curb and Gutter and Sidewalk in New Areas

Constructing new concrete curb, curb and gutter, and sidewalk where indicated will be measured and paid per linear foot for curb and curb and gutter, and per square foot for sidewalks.

C. Non-Payment Items

The following items of work will not be measured for payment but the costs thereof will be considered as incidental to the Contract.

1. **Preparation of subgrade.**
2. **Disposal of removed curb, curb and gutter and sidewalk.**

3. **Replacement and restoration of curb and gutter and sidewalk outside the limits of payment set forth herein which have been disturbed and damaged by the Contractor's operations.**

SECTION 02575

REMOVAL OF PAVING MATERIAL BY MILLING

1. General

A. Description

Removal of bituminous paving material shall consist of removing the existing pavement using cold method. The type of equipment used shall be one that has successfully operated on similar work.

B. Equipment

Cold milling equipment shall be the type using a rotating drum equipped with special teeth which cuts the pavement to a predetermined depth and reduces it in size in the process.

Equipment capable of removing a minimum two and one-half inches (2 ½") of bituminous material with a single pass, is required. This restriction is intended to minimize the difficulties encountered in maintenance of traffic with equipment requiring multiple passes to remove two and one-half inches (2-1/2") of material.

The equipment shall remove the paving material to the required cross-section in not more than one (1) pass at a minimum rate of twenty-five feet (25') per minute.

The cold method equipment shall be equipped with a dust suppression system and shall meet the latest standards set forth by the Air Quality Act for noise and air pollution control.

2. Construction Methods

Removal of paving material operations are to be conducted within the contract limits specified, but are not necessarily intended to be conducted for the entire lengths and widths of the streets listed.

The desirable depth of pavement to be removed shall be sufficient to eliminate ripples and other irregularities to a uniform cross-section and/or riding profile as specified in the specifications.

The depth of removal of materials shall be as specified in the special provisions or contract drawings. In areas where the depth of material is less than the specified depth of removal, the removal will be complete removal of materials to firm base. In areas where the depth of materials exceeds the specified depth of removal, the maximum removal shall be the specified removal depth.

All debris from the surface removal operations shall be swept clean from the street at the end of each working day. No removed materials shall be used in areas where stripping materials are specified. Milled paving material shall include all materials encountered within the depth specified which may include wood, concrete, asphalt paving.

During removal operations, the Contractor shall exercise extreme caution for protection of trees from heat from the equipment. The Contractor shall not stop the equipment under any trees during the performance of this contract.

Weather and seasonal limitations for removal operations will be identical to those given in Section 401.03 for Bituminous Concrete in MSHA Specifications, 1982.

3. Measurement and Payment

The quality of removal of paving material shall be the number of square yards of material acceptably removed, measured in the original position by surface measurements.

This work will be paid for at the contract unit price bid per square yard for "Removal of Paving Materials," which price and payment shall be made on the basis of actual square yards of surface removed including the furnishings of all labor, material, equipment, operators, fuel, oil, gasoline, repairs, blades and other incidentals necessary to complete the work. It shall be understood that depths required to remove corrugations, ripples bumps and/or other irregularities, may vary and shall be deemed to be included in the unit price bid per square yard.

No additional payment will be made for the removal of debris and excess materials. The cost will be included in the contract unit price bid per square yard for "Removal of Paving Materials."

Should the Contractor encounter railroad tracks and ties, lumber, concrete or other unusual material within the asphalt area to be removed, there will be no additional compensation for any special labor, materials, equipment and incidentals necessary to remove the paving materials to the specified depth in these areas.

SECTION 02660

WATER SYSTEM

1. General

A. Description

This section includes construction, testing, disinfecting of permanent water supply, fire protection and distribution piping to the limits indicated in accordance with the Contract Documents

B. Quality Assurance

Water Pressure Testing Maximum Allowable Leakage per AWWA Specifications:

11.65 gallons per mile per inch of diameter per day

City's test is 4 hours @ 150 P.S.I. (Except fire lines 200 P.S.I.)

Sample Calculation: **For one mile of 8" DIP**

$11.65 \times 8 = 93.2$ gallons for one mile for 24 hours

$93.2 / 24 \times 4 = 15.53$ gallons for one mile of 8" DIP (4 hour test)

Factor Method Which Equates to Above Allowable Loss

$0.0003676 \times \text{inches of diameter} \times \text{length of line} = \text{allowable loss 4 hour test}$

Sample using factor method: **One mile of 8" DIP ---- 4 hour test**

$0.0003676 \times 8 \times 5280 = 15.53$ gallons of allowable loss for 4 hours

Test mains for leakage at a sustained internal hydrostatic pressure of 150 pounds per square inch at the highest invert elevation for a minimum period of 4 hours. Maximum allowable leakage shall not exceed 11.65 gallons per inch of diameter of watermain, per mile, per 24 hours.

Should test results show any visible leakage, displacement or damage, the Contractor shall repair the leakage, displacement or damage and retest until specified conditions are met, to the satisfaction of the Engineer, at no cost to the City.

Notify the Engineer three working days before shop testing all valves over 14 inches and all valves which are to be furnished by the Contractor

Quality assurance for precast concrete utility structures is specified in Section 03480 of these Specifications.

Pressure Tests:

Pressure tests for all watermains shall not be performed until all other utilities shown on the approved plans are completed.

C. Submittals

Submit certified test reports or certificates of compliance before delivery of any pipe furnished by the Contractor under this section. Certifications shall include City contract number, job location, contractor's name, types, classes and strengths of pipe and pipe manufacturer's name.

Submit certificates of compliance for all other manufactured material furnished by the Contractor under this section.

A packing list shall accompany every shipment and shall contain the following information: City contract number, truck number, kind and class of pipe, fittings and valves and appurtenances, length of pipe, and other pertinent information.

Submit shop drawings where indicated for precast concrete structures to the City. Submissions shall include City contract number, structure number, contractor's name and supplier's name.

Submit laying schedules for all concrete pipe 16 inches in diameter and larger.

Submit manufacturer's certified drawings of the valves including valve operators, gear ratios and design flows and pressure differential, performance charts and parts list. Furnish manufacturer's certified test reports for all tests specified in the referenced standards and all tests performed on valve operators. Submit a manufacturer's affidavit stating that valves furnished comply with all applicable provisions of the referenced standards and modifications thereto described herein.

Fittings shall be marked with weight, manufacturer's mark, year, month and date cast and number of lot. Couplings shall be marked in accordance with MPS SP-25 Standard Marking System for Valves, Fittings, Flanges and Unions.

D. Design Criteria

1. Concrete pressure pipe shall conform to requirements of AWWA C-301 and the following:

The pipe and fittings shall be designed to withstand the stresses created by the maximum sustained internal hydrostatic pressure, in accordance with the hydraulic gradient or pressure shown on the plans; water hammer of the amount shown in the table for surge pressure below or 40 percent of the operating pressure as per AWWA C-301, whichever is greater; the earth backfill load resulting from the existing ground over the pipe or the proposed finished grade as shown on the plans, whichever is greater; a single H₂O truck load with impact in accordance with ASSHTO Specifications (maximum 30 percent), or single copper E-80 trainload within railroad rights-of-way with diesel impact in accordance with the

American Railway Engineer's Association Specifications, all acting simultaneously, and shall be within transient load curve "T" in accordance with Appendix "A" or "B" of AWWA C-301.

The pipe and fittings shall also be designed to withstand the stresses created by the maximum sustained internal hydrostatic pressure in accordance with the hydraulic gradient or pressure shown on the plan, the earth backfill load resulting from the existing ground over the pipe or the proposed finish grade as shown on the plan, all acting simultaneously, and shall be within design load curve "D" in accordance with Appendix "A" or "B" of AWWA C-301.

TABLE FOR SURGE PRESSURE

| <u>Diameter</u> <u>(Inches)</u> | <u>Surge Pressure</u> <u>(Psi)</u> |
|------------------------------------|---------------------------------------|
| 3 to 10 | 120 |
| 12 to 14 | 110 |
| 16 to 18 | 100 |
| 20 | 90 |
| 40 | 85 |
| 30 | 80 |
| 36 | 75 |
| 42 to 60 | 70 |
| Over 60 | 65 |

The stress created by the loads shown in previous paragraphs shall not exceed by more than 10 percent the stress which creates an incipient crack.

The pipe laying condition shall be a formed trench, compacted backfill, with a ratio to three-edge bearing factor of 1.5.

The earth backfill load shall be as calculated from the Marston Formula using 120 pounds per cubic foot as the soil density and coefficient "C" for ordinary clay.

Pipe in encasement and tunnels shall be designed to meet all the above requirements.

2. Harnessed Joints for Concrete Pressure Pipe

The harnessed joints shall be Bell bolt flexible tied joints, 2 inch exterior bolts or equal. Equations for the length of harnessed joint pipe to dissipate the separating force through frictional resistance are derived as follows:

a. Design Assumptions

- (1) Entire line backfilled to depths of cover shown.

- (2) Static frictional resistance per linear foot based on weight of backfill we (as determined by Marston Equations, $W = CwBd^2$ for trench width, $Bd =$ outside Diameter + 2.0 feet for pipe thru 48 inches; $Bd =$ Outside Diameter + 3.0 feet for pipe over 48 inches), plus weight of pipe, Wp plus weight of water in pipe, Ww (using normal inside diameter).
- (3) Coefficient of static friction (F_n) between pipe and trench bottom of 0.40 unless otherwise noted on plans.
- (4) The longitudinal stress in the pipe cylinder is limited to 12,500 psi at operating pressure.

(b) Design Equations

- (1) Length of harnessed pipe = $L - \frac{1.5 PA}{F_n W}$
at dead ends unless
otherwise shown on drawings
- (2) Length of harness pipe = $L - \frac{1.5 PA (1-\cos B)}{F_n W}$
at bends unless
otherwise shown in drawing

L = length of harnessed pipe (feet)

P = maximum internal pressure (psi) static pressure plus water hammer

A = cross sectional area of pipe based on joint diameter (in²)

B = angle of bend (degrees)

W = combined weights of earth backfill, pipe and water in the pipe (lb. / 1in. ft.)

= $W_e + W_p + W_w$

1.5 = safety factor

(source: Fill Loads on Pipe, ASA A21.1).

- (3) Contractor shall submit details of pipe harnessing and additional strengthening required, together with his computations and shall receive approval from the Engineer before manufacturing the pipe.

E. Inspection

All items furnished by the Contractor under this section shall be inspected by City personnel before installation. Notify the Engineer three working days before proposed inspection. Said inspection will not release the Contractor from responsibility for materials or equipment.

2. Materials

A. Materials Requirements

1. Pipe and Fittings

All pipe of a certain size and material shall be furnished by the same manufacturer. Each pipe length and fitting shall be clearly marked with the manufacturer's name of trademark.

Concrete pressure pipe and fittings shall meet requirements of AWWA C-301. Pipe being laid to a dead end shall be furnished with an outlet suitable for installation of a one inch corporation cock, having Mueller threads, near the dead end for chlorination purposes.

Ductile iron pipe shall meet requirements of AWWA C151 with mechanical joint or push-on joint. Pipe shall be bituminous coated outside and cement lined with double thickness inside in accordance with AWWA C104. Cure cement lining with a bituminous seal coat. Fittings shall be cast iron in accordance with AWWA C110 of the following classes:

Pipe 3 inches through 12 inches, working pressure up to 200 psi, and pipe over 12 inches working pressure up to 150 psi = Class 125B. Where working pressures exceed those listed above, provide Class 250B fittings. Size, dimensions and tolerances shall be as specified in AWWA C111 and the CIPRA Handbook for Ductile Iron and Cast Iron. Provide accessories as required to connect with plain end of slip joint pipe or cut pipe. Gaskets shall be plain rubber and tee head bolts and hexagon nuts shall be low alloy steel, US Alloy, Cortenloy or equal.

Fittings shall be of uniform quality, true to pattern, strong, tough or even grain, sound, smooth, without cold shuts, swells, scabs, blisters and sand holes, cracks or other defects. Plugs, filled holes and welds will not be allowed. Fittings shall be clean and entirely free of grease and oil, substantially free of blacking, dirt, sand, rust, slag and fluxing. Remove rough spots in sockets or on plain ends or walls before lining and coating.

Fittings shall be bituminous coated outside and cement lined with double thickness inside in accordance with AWWA C104.

When watermains with fittings and appurtenances are installed in fill and disturbed areas they shall be constructed (assembled) with Mega Lug, or approved equal flanges.

Flanges shall be cast integrally with body and shall have the same thickness over their entire circumference. Faces shall be perpendicular to axis of pipe.

Bolt holes in fitting flanges shall straddle the vertical centerline when the fitting is positioned to change the fluid flow in a horizontal direction. Drill

or core bolt holes and completely through flanges so as to be free of sand and projections.

Gauge to assure dimensional bolt circle control, location and size of holes and concentricity with the socket or gland lip.

Copper pipe shall be seamless, Type K and meet requirements of ASTM B88. Fittings shall be copper meeting requirements of ASTM B62, free of injurious blowholes, porosity, shrinkage, cracks or other injurious defects, smooth and well cleaned and shall meet requirements of AWWA C800 and the following:

2. Corporation Stops and Couplings

Copper tube outlets of all corporation stops shall be of the flare type and shall be fitted with a coupling nut threaded according to AWWA Specification C-800, which shall have a machined bearing in the skirt part equal to or greater in length than the outside diameter of the corresponding size Type K copper pipe, in inches. Protect inlet threads with a plastic coating in shipment.

The key or plug shall be turned, and the mating surface in the body shall be reamed accurately to a taper of 1-3/4 inches per foot, or 0.1458 inches per inch plus or minus 0.007 inches per abrasive suspensions to insure accurate fit.

The large end of the tape surface of the key shall be reduced in diameter by chamfer or turning for a distance that will bring the largest end of the seating surface of the key below the large diameter of the seating surface in the body; and the taper seat in the body shall be relieved on the small end, and the small end of the key shall extend through the body.

The stem end of the key, key nut and washer shall be so designed that if the key nut be tightened to failure point, the stem of the key shall not fracture. The nut and the stem shall withstand a turning force on the nut of at least three times the necessary effort to properly seat the key without failure in any manner.

All corporation stops shall be so designed as to rotate about the axis of the flow passageway inside the following minimum circle in order to properly clear in the tapping machines:

| <u>Size Stop</u> | <u>Circle of Rotation</u> |
|------------------|---------------------------|
| 1" and under | 2-7/8" |
| 1-1/2" and 2" | 4-15/16" |

For corporation cocks furnished by the Contractor, furnish certificates of compliance stating that all corporation stops have been subjected to a production line test by the manufacturer of 85 psig air pressure while submerged in water, in both open and closed position of the key, and shall show no leakage. Period of observation shall be 10 seconds minimum. Stops shall be subjected to a 300 psig hydrostatic test and shall not leak top or bottom and shall not show signs of structural failure.

3. Curb Stops

The curb stops shall be of the type having an inverted key, round way, combined cap and tee with check, complete with copper couplings for the inlet and outlet. The curb stops and couplings shall be suitable for use with Type K copper tubing, soft temper.

Inlets and outlets of all curb stops shall be of the flare type and shall be fitted with a coupling nut threaded according to AWWA C-800, which shall have a machine bearing in the skirt part equal to or greater in length than the outside diameter of the corresponding size Type K copper pipe, in inches.

Compression curb stops shall be furnished by Mueller or Ford (grip joint), or approved equal. Compression fittings with set screws or retaining screws will not be allowed.

The curb stops shall be suitable for installation in conjunction with the Buffalo Type, new style, two piece screw type curb boxes.

For curb stops furnished by the Contractor, furnish certificates of compliance stating that all curb stops and couplings have been subjected to a production line test by the manufacturer of 85 psig air pressure while submerged in water, in both open and closed position of the key, and shall show no leakage. Period of observation shall be 10 seconds minimum. Stops shall be subjected to a 300 psig hydrostatic test and shall not leak top or bottom and shall not show signs of structural failure.

The copper to copper couplings shall be those known as the two-part type consisting of a tubing connection, a coupling nut and a friction ring. The copper type end of the couplings shall be the flare type for connecting to Type K copper service pipe. The opposite end, and all coupling nuts, shall be threaded in accordance with AWWA C-800. Compression couplings shall be furnished by Mueller or Ford (grip joint), or approved equal. Compression couplers with set screws or retaining screws will not be allowed.

The iron pipe end of all copper to iron pipe fittings shall be threaded in accordance with the National Bureau of Standards Handbook H-28, Standard for American National Pipe Threads.

The copper line coupling shall be one of the following manufacturer's... or equal:

| <u>Description</u> | <u>Mueller</u> | <u>Hays</u> | <u>McDonald</u> | <u>Ford</u> | <u>Farnan</u> |
|--------------------|----------------|-------------|-----------------|----------------|---------------|
| 2 part Cu. To Cu. | H-15405 | 5610 | 4756 | C.S. 22 Series | W-5460 |
| Cu. To Male IPT | H-15425 | 5605 | 4753 | C28 Series | W-5480 |
| Cu. To Female IPT | H-15450 | 5600 | 4754 | C21 Series | W-5550 |

Angle, valves, ground key water meter stops, yoke ells and meter ells shall be sized and shaped so as to fit appropriate size meter, appropriate

yoke number and proper size and type of pipe. These items shall be manufactured by Ford or equal.

Brass nipples shall be standard seamless, threaded, reamed and chamfered and of the proper size required.

Duc-lugs shall be Stellar 14 as manufactured by Flow Industries or equal.

For couplings furnished by the Contractor, records of chemical analysis and tension results shall be systematically made and maintained by the manufacturer. Submit certified test reports in accordance with section stating conformance with the specifications and latest typical analysis and/or tension test results of current manufacturer.

Pipe for meter housing shall be concrete pipe meeting requirements of ASTM C14, lightweight aggregate, concrete $f'c = 3500$ psi, or bituminized fiber with notches meeting requirements set forth hereinafter. Furnish pipe in three foot lengths, diameter 18 inch, 21 inch, or 24 inch.

Bituminized fiber housings shall be composed of a bituminized compound reinforced with an interwoven fibrous structure. The fibrous material shall be adhered with a heat and water resistant adhesive.

For meter housing furnished by the Contractor, furnish certificate of compliance stating that specimens show no evidence of softening or disintegration when tested in accordance with these specifications.

Furnish certificates of compliance for the following tests:

- * Crush Strength Test. **The enclosure shall have a minimum bearing crushing strength as described in Table 1 below (wet or dry) when tested in accordance with ASTM D2315.**
- * Water Absorption Test. **The maximum water absorption shall be not more than 25 percent of the original weight when tested in accordance with ASTM D2315.**
- * Boiling Water Resistance. **Specimen shall retain not less than 90 percent of their dry crushing strength as determined in 5.1 when tested in accordance with ASTM D2315. (If it is not practical to boil a complete enclosure, 6" x 6" cut samples should be prepared and boiled in accordance with the above test method. These samples should show no delamination or separation of piles. These samples are not tested for crush strength.)**
- * Heat Resistance Test. **Specimen shall have no appreciable exudation of pitch or flattening of the enclosure when tested in accordance with ASTM D2315.**

Table 1

| Nominal ID (Inches) <u>+0.070"</u> | Nominal Length (Inches) <u>+0.250</u> | "U" Shaped Notches (2) at 180 Apart On the Bottom <u>+0.125</u> | Minimum <u>Crush Strength</u> | |
|--|--|--|----------------------------------|---------------------|
| | | | S Edge <u>Lbs/lf</u> | Axial <u>lbs</u> |
| 15 | 12, 15, 18,24 30, 36, 48 | 4" long x 3" wide | 450 | 40,000 |
| 18 | 12, 18, 24, 30 36, 48 | 4" long x 3" wide | 450 | 40,000 |
| 20 | 24, 30, 36, 48 | 4" long x 3" wide | 450 | 40,000 |
| 24 | 12, 18, 24, 30 36, 48 | 4" long x 3" wide | 450 | 40,000 |

* Sampling. **Select at random the specimens to be tested from stock of the manufacturer or from shipment. Undamaged specimens only shall be used.**

From each lot to be tested, select a number of pieces equivalent to one half the cube root of the total number of pieces included in a lot except that in lots of 1,000 pieces or less, five pieces shall be taken. If one half the cube root as calculated proves to be a fractional number express it as the next higher whole number.

Concrete shall meet requirements specified in Section 03300 of this specification and shall be of the strength indicated on the plans and Standard Details.

Masonry work shall meet requirements specified in Section 04200 of these specifications.

Precast concrete shall meet requirements specified in Section 03480 of the specifications.

Granular Bedding is specified in Section 02200 of these specifications.

Steel for connections shall meet requirements of ASTM A36 and A301.

4. Joint Material

Lead for joints shall conform to Type A, ASTM B29. Packing shall be square braided hemp free from tar and oil. Push on joints shall conform to requirements of AWWA C111. Flanged joints shall conform to requirements of AWWA C110. Mechanical couplings shall be as indicated, manufactured by Dresser, Smith, Blair or equal.

5. Valves

Gate valves shall be built and tested in accordance with AWWA C500 and shall be cast iron body, bronze mounted, resilient seat gate valves with nonrising stems, nut operated to open right, and of ample strength to withstand and operate under work pressures set forth below. Resilient seat to be in accordance with AWWA C509 – 87, Section 4.12. Valves shall have joints as indicated and shall be as manufactured by Mueller Company, American-Darling Valve Company, Clow Valve Company, United State Pipe and Foundry Company or Kennedy Valve Company. Gearing and bypass are not required on valves smaller than 16 inch. Valves 16 inch and larger shall be equipped with bypass and bevel gearing, tacks and scrapers for horizontal or spur gearing for vertical installations and shall have flanged ends.

Working pressures shall be as follows: Valves up to and including 12 inches: 200 psi including water hammer; valves over 12 inches: 150 psi plus water hammer.

Furnish valves complete with joint material including low alloy bolts as per US Alloy or Cortenloy, rubber gaskets, cast iron glands of strength consistent with valves.

Butterfly valves 72 inches and smaller shall be Class 150B and shall conform to requirements of AWWA C504 as modified and supplemented herein.

Valve manufacturer shall be regularly engaged in the design, manufacture and maintenance of butterfly valves and shall have furnished valves of the same general design, type and comparable size specified herein, which have been used and proved satisfactory under similar test, service and operating conditions for at least five years. The manufacturer shall furnish satisfactory evidence of adequate facilities for furnishing parts of repairs and for maintenance of valves furnished.

Unless otherwise indicated, valves shall be designed to provide tight shut off at 150 psi upstream and 0 psi downstream in either direction. Design flows shall be a minimum 15 feet per second for opening and closing.

Valve bodies shall be equipped with ends suitable for victualic couplings or flanged ends. Interior shall be coated with asphalt varnish meeting requirements of FS TT V 51C, and exterior shall be coated with zinc chromate meeting requirements of FS TT P 645. Rubber seat ring shall be clamped to the disc with a clamp of corrosion resistance material or shall be recess mounted, bonded or mechanically secured to the body, and shall be adjustable and replaceable without disassembly of the valve.

Valve disc shall be of cast iron, ductile iron or steel and shall have a seating edge of 18-8 stainless steel or monel for the full width of the disc seating edge.

Valve shaft shall be 18-8 stainless steel or monel. The shaft shall be parked on the end to indicate the position of the valve disc with respect

to the shaft. Shaft seals shall be Split V or Chevron, of the type utilizing a stuffing box and pull down packing gland, for 24 inch and larger valves.

Valve operator shall be two inch nut with worm gear or traveling nut type, self-locking or equipped with a locking device to hold disc in any position between open and closed. Direction of rotation to close the valve shall be counterclockwise and shall require a minimum of 35 turns from closed to open position. Gearing ratio shall be such that torque required at the operating nut will not exceed 80 foot pounds. For valves 30 inches and larger, worm and gear operations with spur gear attachments shall have a torque limiting device on the input shaft. Operators shall be fully enclosed in a gasketed grease filled enclosure. A metal tag on which the direction and number of turns required to open and close the valves is embossed shall be securely attached to the operator. Operators shall be cast with an arrow at least two inches long and the word "OPEN" in distinct one half inch letters. Operator shall withstand an input of 350 foot pounds to the two inch square nut at extreme operator position without damage.

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 that they are readable.

Butterfly valves larger than 72 inches shall be Class 150B and shall conform to the requirements in AWWA C504 and to the requirements specified hereinabove, as modified below:

- 1) Material for valve bodies shall be cast iron ASTM A 126, Class B, or ASTM A 48, class 40, ductile iron ASTM A 536, Grade 65-45-12, or fabricated steel ASTM A36.
- 2) Provide flat-faced flanges conforming to ANSI A 21.10, Class 250 for working pressures higher than 150 psi.
- 3) Material for valve disc shall be cast iron ASTM A 126, Class B or ASTM A 48, Class 40, ductile iron ASTM A 536, Grade 64-45-12, or fabricated steel ASTM A 36 or ASTM A 516, Grade 60.

Flanged backflow preventer shall be complete with gate valve and the inlet side of the inlet gate valve shall be fitted with the necessary vent cock and fittings. Valve body shall be galvanized cast iron with bronze working parts and springs, plastic coated carbon steel valve discs, neoprene coated cotton duck diaphragm.

Valve shall be designed to suction a maximum working pressure of 175 psi and a hydrostatic test pressure of 350 psi.

Valve shall be Hersey Products, Inc. Model Bosco, Cla-Vel Company or equal.

Air release valves shall be two inch, universal, with surface diameter 1/4 inch, range of working pressure from 0 to 165 pounds, stainless steel float, resilient seat and screwed connection; Crispin Model U-20, Apco Combination Air Release valve Model 145-C or equal.

Globe valves shall be two inches, Class B, meeting requirements of FS WW-51A, 150 pounds screwed.

Fire Hydrants. Fire hydrants for new installation and/or complete replacement (including base elbow) shall be the following model complete with elbows and mechanical joint accessories:

Mueller Centurion traffic Model 473-A with 5-1/4 inch main valve

American-Darling Valve Company Model B-84-B

Clow Valve Company Medallion model Submittal Required *

United States Pipe and Foundry Company Metropolitan 250 Submittal required *

Kennedy Valve Company Model K81A.

*** Model to have features comparable to fire hydrants listed above.**

All other hydrants will need to be equivalent and submitted for review and approval by the City Engineer.

Hydrants shall be provided with one four inch New York Thread pumper and two 2-1/2 inch hose nozzles. Both pumper and hose nozzle threads shall conform to the requirements of ANSI Specifications for the New York coupling screw thread. Nozzle caps shall be provided for all outlets, and shall be attached to the fire hydrants by means of suitable chains. Fasten nozzles into barrel by either leading or threads.

The elbow shall be cast iron or ductile iron in accordance with ANSI-21.10. The inlet connection shall be a 6 inch, Class 250 mechanical joint bell and shall meet the general requirement for Standardized Mechanical Joint Cast Iron Pipe and Fittings, furnished with necessary accessories for each such mechanical joint. The bolts shall be made of low alloy steel such as Corten or US Alloy. The gaskets shall be made of rubber. Glands shall be made of high strength cast iron consistent in design and strength with the elbows with which they are to be used. Elbow or inlet connection shall be shipped assembled with hydrant.

The outside of the hydrant above the finished ground line to a height just above the hydrant nozzles (or to the hydrant bonnet if so constructed) shall be thoroughly cleaned, primed and then painted with two finished coats of D-40 yellow Derusto paint. Top section of hydrant above the nozzles (on the hydrant bonnet, if so constructed) shall be likewise cleaned, primed and painted with two finished coats as follows:

Flows \geq 1000 gpm paint green (safety Derusto)

Flows from 500 gpm to 1000 gpm paint orange (Derusto)

Flows < 500 gpm paint red (safety Derusto)

Paint shall be as manufactured by Grow Chemical Coating Corporation, Tropical Paint Division for this type application or approved equal.

Proposed paint substitution shall be presented to the City with complete details, painting design, paint color chips and at least one pint of the proposed paint.

Paint the inside and outside of the barrel below the ground line and the cast iron elbow inside and outside with bituminous coating; ANSI A-21.10 for potable water.

The bituminous coating shall be of such composition as to make a smooth, tough and tenacious coating, neither so soft as to flow when exposed to the sun nor so brittle as to crack and scale off when exposed to temperatures below freezing.

The bituminous coating may be applied hot or cold, either by brushing, dipping or spraying. The coating materials may be subjected to chemical and physical tests by the City's representatives to confirm its uniformity and quality.

At no time shall there be any evidence of general peeling or scaling of the coating. Any serious damage to the coating because of rough handling or rubbing in shipment or hauling shall be repaired to its original condition by the manufacturer at no cost to the City.

External operating and cap nuts shall be of pentagonal shape. The pentagon shall measure 1-1/2 inches from point to flat at the base of the nut and 1-7/16 inches at the top.

Hydrants shall open by turning operating nut left (counterclockwise). Direction of opening shall be indicated on the top portion of the upper barrel section.

The upper barrel (above grade) of the hydrant shall be cast iron. The lower barrel (below grade) of the hydrant shall consist of one of two cast iron or ductile iron sections. If the lower barrel consists of two sections, the shorter section shall be at least two feet long and shall be located adjacent to the hydrant base. The coupling between the upper barrel and lower barrel shall be at or near finished grade.

The following parts are to be bronze as specified in AWWA C-502:

| | |
|--|-----------------------------------|
| Drain Valve | Valve Seats or Seat Rings |
| Stuffing Box (Bronze-brushed Cast Iron) | Stuffing Box Parts |
| Hold Down Nut | Threaded Stem nut (sleeve) |

The barrel of the hydrant shall be in two cast iron or ductile iron sections, designed to break at or near the finished grade; the cast iron shall

conform to American Standard Specifications ANSI A21.52. The nozzle section shall be attached to the lower barrel section by means of a tapered flange ring held in place by suitable "hydrant head" bolts and nuts. The flange and flange rings shall be so designed that the top or upper barrel section, including the bonnet and operating nut, may be revolved 360 degrees for facing without disturbing the bottom section of the barrel. The use of a split bronze insert ring will not be permitted.

Fire hydrant connection appurtenances shall be as follows:

- (1) 4" x 2-1/2" x 2-1/2" rough cast brass "U" branch connection, with 4 inch inlet with New York threads and 2-1/2 inch outlets to have male ASA threads (7-1/2 threads per inch) for use with fire hose coupling. Provide eye opening to hold "S" chain hooks cast on top centered between the 2-1/2 inch connections.
- (2) Anchor coupling shall be from 12 to 13 inches long, weighing approximately 70 pounds, double thickness cement lined and bituminous sealed as per AWWA C104, six inch cast iron mechanical joint, Class 250 with integrally cast standard mechanical joint gland on one end and one loose end rotatable ductile iron gland on the other end. The plain end shall be of sufficient dimension to form a mechanical joint with a six inch mechanical joint bell.
- (3) Straps, bolts and nuts shall meet requirements of ASTM A36 and A301 as specified in Section 05500.

Castings shall be grey iron conforming to the requirements of ASTM A48, Grade 35.

Bituminous coatings shall be coal tar epoxy conforming to requirements of MIL P23236P, Class 2. Coatings in contact with potable water shall meet requirements of AWWA C203 and jurisdictional Health Department requirements.

6. Connection Appurtenances

- (1) Tapping sleeves shall be mechanical joint, furnished complete with plain rubber gaskets, mechanical joint accessories, duck tipped or armored tipped, and with duckback gaskets suitable for use on ductile iron pressure pipe. Hub sleeves shall fit Class D pipe with maximum allowance for outside diameter. Connecting flange joint between sleeve and valve shall conform to MSS (Manufacturer's Standardization Society of the Valve and Fitting Industry) Standard SP60 for pipe up to 12 inches in diameter. Outlet flanges for pipes larger than 12 inches shall be designed to receive the valves furnished. Ship complete with rings, gaskets, bolts in place and ends of sleeve covered. Mechanical joint tapping valves shall have inlet flanges by the mechanical joint outlets, be subjected to a test pressure of 300 psi, be designed for working pressure of 150 psi and shall meet other requirements specified hereinbefore specified for gate valves.

The City will tap the pipe and furnish and install the one inch corporation cocks and couplings therein after Contractor has tested the line.

- (2) All other types of pipe: Where directed by the Engineer, the Contractor shall tap the pipe and furnish and install one inch corporation cocks and couplings therein.
- (3) The Contractor will provide the chlorine and introduce it into the pipes and provide necessary flushing as per AWWA C-600. During chlorination, while the main is pressurized, taps for house connection may be made.
- (4) After chlorination, the City will take and analyze samples within 72 hours. The mains will not be placed in service until the analysis is complete.
- (5) While the analysis is being performed, the Contractor may pressurize the main for the purpose of making taps by installing tubing with an approved backflow preventer around the valve. These shall be removed as soon as the taps are completed.

The Contractor shall perform excavation and backfill for the above items and shall cooperate and coordinate with City forces during performance of the work.

B. Laying Pipe

Trench excavation and backfill and test pits shall be as specified in Earthwork Section 02200. Before commencing excavation at each location, dig test pits as directed by the Engineer to determine size and types of pipe and slope of water pipe to be rebuilt. Excavate test pits as specified sufficiently in advance of trench construction so that reasonable changes in line and grade can be made where the location of existing structure varies from that shown. The Contractor shall adjust pipeline profile as required at connections to existing mains, subject to the approval of the Engineer. Completely excavate sufficient trench to assure that no unforeseen obstructions exist before commencing pipe installation. Work occasioned by failure to take such precautions shall be performed at no cost to the City.

Provide granular bedding under all pipe except as specified herein in accordance with the Standard Details and Specifications for Earthwork. Provide concrete encasement and/or cradle where indicated. Insure that pipes are well bedded. Granular bedding is not required for ductile iron pipe through 24 inches in diameter and copper house connection pipe.

Clean each pipe and fitting of foreign substances before placing in trench and keep clean thereafter. Remove pipe whose interior has been contaminated with oil, gasoline, kerosene or material which damages the cement or the bituminous linings and replace at no cost to the City. Should foreign material or contaminants be observed in previously laid pipe, cease work until foreign

material or contaminated pipe is removed. Close open ends of pipes and fittings with a watertight seal during periods when work is not proceeding.

Installation

Align pipe so that no shoulder or unevenness results on the inside of the main. Cutting, where required, shall be smooth and at right angles to the pipe axis. Cutting shall be performed at no cost to the City. Secure pipes, fittings and valves in place in the manner directed on the plans. Where indicated, provide erosion checks or concrete anchors in accordance with the Standard Details. If no method for securing pipe is indicated, secure with wooden wedges or braces to the satisfaction of the Engineer.

Joint openings for prestressed concrete pipe specified in the lay schedule shall not exceed one half inch. Maximum allowable joint opening installed in the field shall be as follows:

| <u>Pipe Size</u> | <u>Maximum Joint Opening</u> |
|------------------|------------------------------|
| Thru 36" | 1/2" |
| 42" thru 60" | 3/4" |
| 66" thru 102" | 1" |
| 108" thru 144" | 1-1/4" |

For all other types of pipe, unless otherwise indicated, horizontal or vertical deflections of 4-1/2 degrees, or less, will be allowed and may be obtained by means of beveled joint rings, by deflecting straight pipe, by using short lengths of pipe, or by any combination of these methods. Horizontal and vertical deflections of more than 4-1/2 degrees shall be made with special fittings approved by the Engineer.

Harnessed Joints

The Contractor shall furnish and install harnessed joints on the pipe to withstand forces shown on the drawings. Twenty foot lengths shall be used in all curves and on both sides of harnessed joints and within the limits as shown on the drawings.

If the Contractor, for his convenience, tests the pipeline before backfilling is complete, he shall provide adequate temporary blocking at no cost to the City.

Retainer glands shall be used for harnessing joints on ductile iron pipe where practicable, in accordance with the Standard Details.

Lead Joints

Provide lead joints in making hookups to existing water mains where bell and spigot joints are required, and where directed by the Engineer. Joints shall be made of square, unlubricated braided hemp packing and lead.

Assemble joints in accordance with AWWA C600 and as specified herein. Clean bell and spigot with a wire brush and obtain smooth surfaces free of rust and foreign materials. During cold weather, heat the ends of the pipe and ensure their dryness. Center spigot in adjacent bell to provide uniform thickness of joint. When single strand packing is required, cut packing in one piece lengths for each joint and place around spigot of pipe allowing a minimum two inch lap. When more than one strand is required, cut lengths to meet without overlap. Place multiple strands with ends on opposite sides, not at top or bottom. Drive home each strand of packing separately with a roping tool and sufficiently compact packing to prevent lead from flowing through into the interior. Leave space in the bell of the pipe so that not less than three inches in depth will be occupied by lead.

Remove dross from lead before pouring. Fill each joint with one continuous pour using a runner fitted against the face of the bell and outside of pipes. Maintain temperature of lead by approved means. After cooling, caulk lead joints with pneumatic or hand tools until thoroughly compacted and watertight. Caulk from the bottom up. Provide hard and even hammered finished surface.

Mechanical joints

Mechanical joints consist of rubber gaskets, cast iron gland rings, bolts and hexagonal nuts. Prior to assembling joint, clean both pipe sections to be in contact with the gasket with a wire brush so as to obtain a clean, smooth surface free of rust and foreign materials.

Assemble joints in accordance with AWWA C111 and C600 and as specified herein. Clean and lubricate contact surfaces with vegetable oil soap. Slip the gasket over the spigot and into the bell. Center the spigot end in the bell. Complete the joint by alternate tightening of bolts with a torque wrench set at 55 pounds, so that the gland and face of the flange present parallel faces during the procedure.

Where satisfactory sealing of the joint is not attained at the maximum permissible torque, disassemble, reclean and reassemble the joint with a new gasket.

Push-On Joints

Push-on joints consist of circular rubber gasket which fits into a specifically designed bell or socket end of the pipe and a specially prepared lubricant. File or grind the spigot on field cut pipe lengths to resemble the pipe as manufactured so that the spigot end will slip into the socket intact without hindrance or gasket damage. Place an identifying mark on pipe that is not furnished with a depth mark on the spigot to show the depth of the socket.

Assemble joints in accordance with AWWA C600 and as specified herein. Clean the inside of the socket and outside of the spigot and the pipes to be jointed to obtain clean, smooth surfaces free of foreign materials. Apply a thin film of gasket lubricant furnished by the joint manufacturer to the inside surface of the gasket and to the outside surface of the spigot. Enter the spigot

into the socket. Complete the joint by forcing the spigot into the socket up to the depth mark, using equipment designed for this purpose.

Concrete Pressure Pipe joints

Concrete pressure pipe joints consist of a metal joint ring and rubber gasket. Joint material shall meet requirements of AWWA C301. Install in accordance with the manufacturer's recommendations. Rubber gasket shall be the sole means of watertightness.

After homing the pipe, fill exterior annular spaces with cement mortar. Fill interior annular spaces of pipe 30 inches and larger with mortar and wipe to provide a smooth and even surface. Mortar mix shall be as recommended by the pipe manufacturer.

C. Fittings and Valves

Install fittings and valves where indicated on the plans. Set fittings and valves and join to pipe as hereinbefore specified. Where valves occur on the end of a pipeline, place a cast iron plug or blind flange and secure in the exposed bell before backfilling the trench.

Provide a valve box and extension stem where required for the following: Nut operated valves; valves on which the operating mechanism is enclosed in a grease case; valves 16 inches or larger in diameter; valves with exposed gearing or operating mechanism; air valves.

Set valve box at right angle to the watermain, centered and plumb over the operating nut of the valve extension stem with nut from six inches to one foot below top of cover with the box cover flush with the surface of the finishing grade. Support as required to maintain nut in position. Before installation, ascertain that valves are in proper working order. If valves are not operated properly, notify the Engineer immediately. Backfill and compact under and around valve boxes to ensure no vertical loads are transmitted to the valve operators.

D. Fire Hydrants

Install fire hydrants where indicated on the plans in accordance with Standard Details. Set plumb at the elevation directed by the Engineer. Place the steamer outlet normal to the street line. Strap fire hydrants to main as shown on the Standard Details.

Lay fire hydrant connections level, in the manner specified hereinbefore for laying pipe.

E. Water House Connections

Provide water house connections from the water mains to property lines at elevations indicated on the plans, Standard Details or as directed by the Engineer. Install corporation cocks, curb stops and motors where indicated. Mark the location of the end of the water connection pipe at the property line

with a 2 x 4 timber, painted blue, placed vertically from the bottom of the trench and extending two feet above grade. Except where otherwise specified herein, dry tapping of the watermain and insertion of the corporation cock shall be performed by qualified personnel having in their possession a qualification card issued by the City for the performance of the work. Taps for water house connections to be made under pressure by contractor utilizing a copper jumper (minimum 3/4"). Water house connections to be laid prior to final connection to existing watermain. City forces shall make wet taps utilizing tapping sleeve and valve.

Provide a service saddle where tapping a three or four inch cast iron or ductile iron water pipe for a one or one-and-one-half corporation cock. Maintain a minimum of 18 inches from tap to the bell end of the pipe. After making the connection and completing the installation, open and leave open the corporation cock.

Do not tap dry mains unless directed by the Engineer. If so directed, make the tap as specified herein and leave the trench open at the tap until the watermain has been placed in service and the taps have been inspected.

Install house connections with outside meters as specified elsewhere herein.

Right-of-way house connections shall be a minimum of two feet of copper pipe from corporation cock to curb stop. Excavate minimum of 5 feet beyond end of water house connection.

F. Corporation Cock for Chlorination Purposes

Provide one inch corporation cock and coupling in watermains for chlorination purposes where directed by the Engineer.

G. Valve Vaults and Manholes

Provide valve vaults and manholes where indicated on the plans in accordance with applicable sections of the specifications and Standard Details. Do not complete to final grade until grading is complete and proper alignment is insured. Set frames in full beds of mortar as indicated on the Standard Details. Space steps as indicated on the Standard Details and the plans.

H. Buttresses, Anchorage and Harnessing

Provide buttresses, anchorages and harnessing where indicated on the plans or directed by the Engineer in accordance with the Standard Details. The Engineer will inspect and approve excavations before buttresses and anchorages are placed. The entire face of the excavation against which buttresses will bear shall be firm bearing, flat and at proper angle to the pipe connections.

I. Connections to Existing Lines

Before the start of construction, dig test pits on all connections to existing work. The Engineer will examine the test pits and establish line and grade and determine material required at connections.

Notify the Engineer at least three working days prior to proposed connection construction. Make connections at such time and in such a manner as the Engineer directs.

The City will notify the consumers and operate all valves necessary to shut off the mains. The City will make every reasonable effort to have tight shut offs, but does not warrant that the mains will be dry. Complete the connections with the greatest possible speed.

Certain information is shown on the drawings relative to existing pipe and other construction. This information was transferred from existing records and is deemed to be reliable but the City does not warrant or guarantee that either the locations, the dimensions or the type of material are exactly as shown.

Water House Connection Renewals. Unless otherwise directed, utilize existing tap at main line water. Provide a watertight installation without the use of collars at the joints.

Where directed by the Engineer, abandon the existing tap and retap the main line water pipe.

Furnishing material for and tapping main line water pipe shall be performed by experienced personnel having in their possession a current qualification card issued by the City. Prestressed concrete pipe will be tapped by City personnel.

Provide corporation cocks and couplings and curb stops at each house connection in accordance with the Standard Details. Stops shall be turned to "off" position prior to installation.

Where directed by the Engineer, provide meter housings and meter yokes and ells in accordance with the Standard Details.

Install mainline water valve/ valves at the end of any temporary termination utilizing restrained joint mechanical joint fittings and/or anchor block as per Detail W-4.

Where existing galvanized pipe with double connection requires replacement, provide two single connections and house connections pipes as specified above and new tap or taps as required.

J. Abandonment

Cap ends of cut mains as shown. Place concrete blocking to bear between the cap on the live main and solid earth.

Where mains are to be abandoned and removed to a tee or valve, cut and plug main at tee or cross, remove all abandoned valves and valve boxes within the limits of abandonment and deliver to the City.

Abandon house service connections by disconnection at the corporation stop.

For watermains 20 inches in diameter and larger being abandoned, construct a brick bulkhead nine inches thick or install an approved plug or cap at each location where the pipe was cut or valve removed.

For watermains smaller than 20 inches in diameter, install bulkheads using brick masonry, 2500 psi concrete, cast iron plugs or cast iron caps at the end of abandoned sections.

Remove valve vault top slab and lower vault walls to a minimum depth of two feet below finished grade. Break up base slab to provide drainage and backfill vault structures as specified elsewhere in these Specifications.

Salvage frames and covers, reuse when approved. Deliver surplus and approved frames and covers by City.

3. Measurement and Payment

A. Pipe Furnished by the Contractor

Furnishing and installing pipe will be measured for payment by the linear foot of the various types and size provided, measured horizontally along the centerline of the pipe. No deductions will be made for the lengths of the fittings, connections or valves.

Payment will be made for the quantities measured for each size at the unit price per linear foot listed in the Bid Schedule.

Payment will include provision of fittings, valves, valve boxes, branch connections and connections to new and existing facilities and corporation cocks and couplings for chlorination.

B. House Connections

Installing house connections will be measured for payment by the linear foot of various types and sizes provided, measured horizontally along the centerline of the pipe from the center of the main to the limits indicated on the plans. No deductions will be made for the lengths of the fittings, connections or valves.

Payment will be made for the quantities measured at the unit price per linear foot listed for each size on the Bid Schedule.

Payment will include installation of fittings, curb stops, corporation cocks, valves, valve boxes and connections to new and existing facilities.

Payment will include excavation, bedding and backfill as specified in Section 02200.

C. House Connection with Outside Meters.

Installing house connection with outside meter will be measured for payment by the linear foot of the various types and sizes provided, measured horizontally along the centerline of the pipe from the center of the main to the limits indicated on the plans. No deduction will be made for the lengths of the fittings, connections, or valves.

Payment will be made for the quantities measured for each size at the unit price per linear foot listed in the Bid Schedule.

Payment will include installation of fittings, valves, valve boxes, meter housings and installation of meter and connections to new and existing facilities.

Payment will include excavation, bedding and backfill as specified in Section 02200.

D. Fire Hydrants

Installing fire hydrants will be measured for payment by each hydrant installed complete in place, including six inches of the lead pipe to the main and including parts of connections as shown on the Standard Details, strapping and blocking and buttresses and incidental appurtenances.

Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.

Payment will include excavation, bedding and backfill as specified in Section 02200.

E. Structures

Providing valve vaults, meter housings, Type A and B blowoffs, valve manholes and manholes will be measured for payment by each of the various types and sizes installed complete in place including installation of City frame and covers.

Payment will be made for the quantities measured at the unit price per each of the various types and sizes as listed in the Bid Schedule.

Payment will include excavation, bedding, backfill and installation of pipes and fittings as required from the main.

F. Meter Vaults

Providing meter vaults will be measured for payment by each of the various types and sizes installed complete in place including installation of City frame and cover.

Payment will be made for the quantities measured at the unit price per each of the various types and sizes as listed in the Bid Schedule.

Payment will include excavation and backfill, installation of lead pipe from main line tee and connection to meter vault and installation of valve and valve box where occurs.

G. Furnishing Pipe in Tunnels

Furnishing and installing pipe in tunnels shall be measured by the linear foot measured along the centerline of the tunnel from inside face to inside face to access shafts.

Payment will be made for the quantities measured for the various sizes of the pipe at the unit prices listed in the Bid Schedule.

H. Non-Payment Items

The following items will not be measured for payment, but the cost thereof will be considered as incidental to the Contract.

- 1. Removal of existing facilities that interfere with the project.**
- 2. Abandonment, plugging, blocking or bricking shut and disposal of existing facilities.**
- 3. Restoration and restabilization of disturbed areas.**
- 4. Erosion checks.**
- 5. Concrete anchors.**
- 6. Harnessing and blocking.**
- 7. Testing.**
- 8. Chlorination.**
- 9. Timber marking house connections.**
- 10. Replacement of various appurtenant connections and devices required for watertight installations.**
- 11. Removal and salvage of existing City facilities and delivery to appropriate locations.**
- 12. Installation of new valves on existing mains.**

SECTION 02661

CHLORINATION OF WATER SYSTEM

1. General

A. Description

This section modifies and supplements Standard Specifications Section 02660, to include requirements for Contractors to chlorinate all watermains.

B. Quality Assurance

Bacteriological testing will be performed by City laboratories.

Bacteriological samples will be collected by City employees.

2. Materials

A. All chlorination materials shall conform AWWA Standards.

3. Execution

A. Work performed by the Contractor.

The Contractor shall introduce chlorine to all new mains. Use continuous feed method or slug method for chlorination as outlined in AWWA C651-86 with latest revisions, for disinfecting watermains.

Water for disinfection and filling the mains shall be supplied from a temporary jumper with approved backflow preventer.

All chlorine shall be introduced in solution. Use of dry chlorine in the pipes will not be permitted. Feed chlorine solution at a constant rate using a force pump.

1. Continuous Feed Method

Proportion mixture of chlorine solution and water so that a minimum of 50 mg/l available chlorine concentration is placed into the main. Fill entire line and appurtenances with this concentration of chlorinated water. Retain concentrated chlorinated water in the main for a 24 hour period.

At the end of the 24 hour period, the treated water shall contain no less than 25 mg/l chlorine throughout the main.

Flush out mains at the end of the 24 hour period using the jumper until the water has a chlorine residual of two tenths (0.2 mg/l to one (1.0) mg/l.

2. Slug Method

Proportion mixture of chlorine solution and water so that a minimum of 300-mg/l chlorine concentration is placed in the main. Apply 300 mg/l concentration for sufficient time to expose all interior surfaces for 3 hours.

Flush concentrated water out of the new mains using the jumper until the water has a chlorine residual of two tenths (0.2) mg/l to one (1.0) mg/l.

Notify the Engineer to have bacteriological samples taken after the flushing.

Should residual and bacteriological analyses not be satisfactory to the Engineer, the Contractor shall re-chlorinate the main and notify the Engineer to take new samples. Re-Chlorination shall be at the Contractor's expense.

The mains shall not be placed into service until the analysis is complete and satisfactory to the Engineer.

B. Work Performed by the City

The City will operate all valves for shutdowns and placing mains in service.

The City will take bacteriological samples within 72 hours after notification by the Contractor. Results of the sample analysis will be available within 72 hours after sampling.

The City will open valves and place the new mains in service after notification of satisfactory results from the bacteriological samples.

SECTION 02700

STORM DRAIN AND SANITARY SEWER SYSTEMS

1. General

A. Description

This section includes all work necessary to provide storm drain and sanitary sewer systems complete in place to the limits indicated in accordance with the Contract Documents.

B. Quality Assurance

Tests to be performed as outlined in this section shall not be performed until all other utilities shown on the approved plans are completed.

1. Sanitary Sewer Manhole Field Tests

Manholes and other structures shall be vacuum tested for water tightness after all connections have been made, and before backfilling. Final tests must be performed after the manholes and other structures have been backfilled.

After backfilling, manholes and other structures shall be visually inspected by the Engineer for leakage. Any visible leak shall be sealed or resealed until all leakage into the unit is satisfactorily eliminated. Final vacuum testing of the manholes or other structures shall be conducted only after the sewers attached to the structures have been air tested, and after final adjustments to finished grade have been made, and prior to final inch of paving. Air testing shall be in accordance with the following subsection: Sanitary Sewer Field Tests.

Manholes to be vacuum tested shall have ten (10) inches of mercury applied to the manhole and the time measured for the vacuum to drop from ten (10) inches to nine (9) inches of mercury. Vacuum equipment shall be approved by the Engineer prior to its use. Following are minimum allowable test times for manhole acceptance at the specified vacuum drop:

| <u>Depth of Manhole</u> | <u>Time (sec)</u> | | |
|-------------------------|----------------------------------|------------|------------|
| | <u>Manhole Diameter (inches)</u> | | |
| | <u>48"</u> | <u>60"</u> | <u>72"</u> |
| 4' | 7 | 9 | 12 |
| 8' | 14 | 18 | 23 |
| 10' | 17 | 23 | 28 |
| 12' | 21 | 28 | 34 |
| 14' | 25 | 32 | 40 |

| <u>Depth of Manhole</u> | <u>Time (sec)</u> | | |
|-------------------------|----------------------------------|------------|------------|
| | <u>Manhole Diameter (inches)</u> | | |
| | <u>48"</u> | <u>60"</u> | <u>72"</u> |
| 16' | 28 | 37 | 45 |
| 18' | 32 | 41 | 51 |
| 20' | 35 | 46 | 57 |
| 22' | 39 | 51 | 62 |
| 24' | 42 | 55 | 68 |
| 26' | 46 | 60 | 74 |
| 28' | 49 | 64 | 80 |
| 30' | 53 | 69 | 85 |

Test times for structures other than manholes will be based on the times for manholes of the nearest equivalent volume or as directed by the Engineer.

AIR TEST TABLES

6" & 8"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE
TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| | | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 6" DIAMETER | | | |
|--|-----|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|-----|-----|-----|
| | | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| LENGTH OF LATERAL IN FEET 4" DIAMETER | 25 | 14 | 24 | 34 | 44 | 54 | 64 | 74 | 84 | 94 | 103 | 113 | 123 | 163 | 168 |
| | 50 | 19 | 29 | 39 | 48 | 58 | 68 | 78 | 88 | 98 | 108 | 118 | 128 | 166 | 167 |
| | 75 | 23 | 33 | 43 | 53 | 63 | 73 | 83 | 92 | 102 | 112 | 122 | 132 | 164 | 165 |
| | 100 | 28 | 37 | 47 | 57 | 67 | 77 | 87 | 97 | 107 | 117 | 127 | 136 | 162 | 163 |
| | 125 | 32 | 42 | 52 | 62 | 72 | 81 | 91 | 101 | 111 | 121 | 131 | 141 | 160 | 162 |
| | 150 | 36 | 46 | 56 | 66 | 76 | 86 | 96 | 106 | 116 | 125 | 135 | 145 | 159 | 161 |
| | 175 | 41 | 51 | 61 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 157 | 159 |
| | 200 | 45 | 55 | 65 | 75 | 85 | 95 | 105 | 114 | 124 | 134 | 144 | 153 | 156 | 158 |
| | 225 | 50 | 59 | 69 | 79 | 89 | 99 | 109 | 119 | 129 | 139 | 149 | 151 | 154 | 157 |
| | 250 | 54 | 64 | 74 | 84 | 94 | 103 | 113 | 123 | 133 | 143 | 149 | 150 | 153 | 156 |
| | 275 | 58 | 68 | 78 | 88 | 98 | 108 | 118 | 128 | 138 | 146 | 147 | 149 | 152 | 155 |
| | 300 | 63 | 73 | 83 | 92 | 102 | 112 | 122 | 132 | 142 | 145 | 146 | 147 | 151 | 154 |
| | 350 | 72 | 81 | 91 | 101 | 111 | 121 | 131 | 140 | 141 | 143 | 144 | 145 | 149 | 152 |
| | 400 | 80 | 90 | 100 | 110 | 120 | 130 | 136 | 138 | 139 | 141 | 142 | 143 | 147 | 150 |
| | 450 | 89 | 99 | 109 | 119 | 129 | 132 | 134 | 136 | 138 | 139 | 141 | 142 | 145 | 149 |
| | 500 | 98 | 108 | 118 | 126 | 129 | 131 | 133 | 135 | 136 | 138 | 139 | 140 | 144 | 147 |

| | | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 8" DIAMETER | | | |
|--|-----|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|-----|-----|-----|
| | | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| LENGTH OF LATERAL IN FEET 4" DIAMETER | 25 | 22 | 40 | 57 | 75 | 92 | 110 | 128 | 145 | 163 | 180 | 198 | 216 | 223 | 224 |
| | 50 | 26 | 44 | 62 | 79 | 97 | 114 | 132 | 150 | 167 | 185 | 202 | 218 | 220 | 221 |
| | 75 | 31 | 48 | 66 | 84 | 101 | 119 | 136 | 154 | 172 | 189 | 207 | 214 | 217 | 219 |
| | 100 | 35 | 53 | 70 | 88 | 106 | 123 | 141 | 158 | 176 | 194 | 209 | 211 | 214 | 216 |
| | 125 | 40 | 57 | 75 | 92 | 110 | 128 | 145 | 163 | 180 | 198 | 206 | 207 | 211 | 214 |
| | 150 | 44 | 62 | 79 | 97 | 114 | 132 | 150 | 167 | 185 | 201 | 202 | 204 | 209 | 212 |
| | 175 | 48 | 66 | 84 | 101 | 119 | 136 | 154 | 172 | 189 | 197 | 199 | 201 | 206 | 210 |
| | 200 | 53 | 70 | 88 | 106 | 123 | 141 | 158 | 176 | 192 | 194 | 197 | 199 | 204 | 208 |
| | 225 | 57 | 75 | 92 | 110 | 128 | 145 | 163 | 180 | 189 | 192 | 194 | 196 | 202 | 206 |
| | 250 | 62 | 79 | 97 | 114 | 132 | 150 | 167 | 183 | 186 | 189 | 191 | 193 | 200 | 204 |
| | 275 | 66 | 84 | 101 | 119 | 136 | 154 | 172 | 181 | 186 | 187 | 189 | 191 | 198 | 202 |
| | 300 | 70 | 88 | 106 | 123 | 141 | 158 | 174 | 178 | 181 | 184 | 187 | 189 | 196 | 200 |
| | 350 | 79 | 97 | 114 | 132 | 150 | 166 | 170 | 174 | 177 | 180 | 183 | 185 | 192 | 197 |
| | 400 | 88 | 106 | 123 | 141 | 157 | 162 | 166 | 170 | 174 | 176 | 179 | 181 | 189 | 194 |
| | 450 | 97 | 114 | 132 | 148 | 154 | 139 | 163 | 167 | 170 | 173 | 176 | 178 | 186 | 191 |
| | 500 | 106 | 123 | 140 | 146 | 151 | 156 | 160 | 164 | 167 | 170 | 173 | 175 | 183 | 189 |

| | | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 8" DIAMETER | | | |
|--|-----|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|-----|-----|-----|
| | | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| LENGTH OF LATERAL IN FEET 6" DIAMETER | 25 | 28 | 45 | 63 | 80 | 98 | 116 | 133 | 151 | 168 | 186 | 204 | 221 | 226 | 225 |
| | 50 | 37 | 55 | 73 | 90 | 108 | 126 | 143 | 161 | 178 | 196 | 214 | 220 | 222 | 223 |
| | 75 | 47 | 65 | 83 | 100 | 118 | 135 | 153 | 171 | 188 | 206 | 217 | 217 | 220 | 221 |
| | 100 | 57 | 75 | 93 | 110 | 128 | 145 | 163 | 181 | 198 | 214 | 214 | 215 | 218 | 220 |
| | 125 | 67 | 85 | 102 | 120 | 138 | 155 | 173 | 190 | 208 | 211 | 212 | 213 | 216 | 218 |
| | 150 | 77 | 95 | 112 | 130 | 148 | 165 | 182 | 200 | 207 | 209 | 210 | 211 | 214 | 217 |
| | 175 | 87 | 105 | 122 | 140 | 157 | 175 | 192 | 204 | 206 | 207 | 208 | 209 | 213 | 215 |
| | 200 | 97 | 114 | 132 | 150 | 147 | 185 | 201 | 202 | 204 | 205 | 206 | 207 | 211 | 214 |
| | 225 | 107 | 124 | 142 | 160 | 177 | 195 | 199 | 201 | 203 | 204 | 205 | 206 | 210 | 213 |
| | 250 | 117 | 134 | 152 | 169 | 187 | 195 | 198 | 199 | 201 | 202 | 203 | 204 | 209 | 212 |
| | 275 | 127 | 144 | 162 | 179 | 192 | 194 | 196 | 198 | 200 | 201 | 202 | 204 | 208 | 210 |
| | 300 | 136 | 154 | 172 | 187 | 190 | 192 | 195 | 196 | 198 | 200 | 201 | 202 | 207 | 209 |
| | 350 | 156 | 174 | 181 | 185 | 187 | 190 | 193 | 194 | 196 | 198 | 199 | 200 | 205 | 208 |
| | 400 | 173 | 178 | 181 | 184 | 186 | 189 | 191 | 192 | 194 | 196 | 197 | 198 | 230 | 206 |
| | 450 | 173 | 177 | 180 | 183 | 185 | 187 | 189 | 190 | 192 | 194 | 195 | 196 | 201 | 204 |
| | 500 | 173 | 177 | 180 | 182 | 184 | 186 | 188 | 189 | 191 | 192 | 193 | 194 | 200 | 203 |

AIR TEST TABLES

10"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE
TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| LENGTH OF LATERAL IN FEET 4" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 32 | 59 | 87 | 114 | 142 | 169 | 197 | 224 | 252 | 277 | 277 | 278 | 279 | 280 |
| 50 | 36 | 64 | 91 | 119 | 146 | 174 | 201 | 229 | 256 | 271 | 272 | 273 | 275 | 277 |
| 75 | 41 | 68 | 96 | 123 | 151 | 178 | 206 | 233 | 261 | 265 | 267 | 268 | 272 | 274 |
| 100 | 45 | 73 | 100 | 128 | 155 | 183 | 210 | 238 | 258 | 260 | 262 | 264 | 268 | 271 |
| 125 | 50 | 77 | 105 | 132 | 160 | 187 | 214 | 242 | 253 | 255 | 257 | 259 | 264 | 268 |
| 150 | 54 | 81 | 109 | 136 | 164 | 191 | 219 | 244 | 248 | 251 | 253 | 255 | 261 | 265 |
| 175 | 58 | 86 | 113 | 141 | 168 | 196 | 223 | 239 | 243 | 246 | 249 | 251 | 258 | 262 |
| 200 | 63 | 90 | 118 | 145 | 173 | 200 | 228 | 235 | 239 | 242 | 245 | 248 | 255 | 260 |
| 225 | 67 | 95 | 122 | 150 | 177 | 205 | 226 | 231 | 235 | 239 | 242 | 244 | 252 | 257 |
| 250 | 72 | 99 | 127 | 154 | 182 | 209 | 222 | 227 | 231 | 235 | 238 | 241 | 249 | 255 |
| 275 | 76 | 103 | 131 | 158 | 186 | 211 | 218 | 223 | 228 | 231 | 235 | 238 | 247 | 253 |
| 300 | 80 | 108 | 135 | 163 | 190 | 208 | 214 | 220 | 224 | 228 | 232 | 235 | 244 | 250 |
| 350 | 89 | 117 | 144 | 172 | 194 | 201 | 208 | 213 | 218 | 222 | 226 | 229 | 239 | 246 |
| 400 | 98 | 125 | 153 | 179 | 188 | 196 | 202 | 208 | 213 | 217 | 221 | 224 | 235 | 242 |
| 450 | 107 | 134 | 162 | 174 | 183 | 191 | 197 | 303 | 208 | 212 | 216 | 220 | 230 | 238 |
| 500 | 116 | 143 | 160 | 170 | 179 | 186 | 193 | 198 | 203 | 208 | 212 | 215 | 226 | 235 |

| LENGTH OF LATERAL IN FEET 6" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 37 | 65 | 92 | 120 | 147 | 175 | 202 | 230 | 257 | 277 | 278 | 278 | 279 | 280 |
| 50 | 47 | 75 | 102 | 130 | 157 | 185 | 212 | 240 | 267 | 271 | 272 | 273 | 276 | 277 |
| 75 | 57 | 85 | 112 | 140 | 167 | 195 | 222 | 250 | 265 | 266 | 267 | 269 | 272 | 274 |
| 100 | 67 | 95 | 122 | 150 | 177 | 205 | 232 | 257 | 260 | 262 | 263 | 265 | 269 | 271 |
| 125 | 77 | 105 | 132 | 160 | 187 | 215 | 242 | 253 | 255 | 257 | 259 | 261 | 266 | 269 |
| 150 | 87 | 114 | 142 | 169 | 197 | 224 | 245 | 248 | 251 | 254 | 256 | 257 | 263 | 266 |
| 175 | 97 | 124 | 152 | 179 | 207 | 234 | 241 | 245 | 248 | 250 | 252 | 254 | 260 | 264 |
| 200 | 107 | 134 | 162 | 189 | 217 | 233 | 237 | 241 | 244 | 247 | 249 | 251 | 258 | 262 |
| 225 | 117 | 144 | 172 | 199 | 225 | 230 | 234 | 238 | 241 | 244 | 246 | 248 | 255 | 260 |
| 250 | 127 | 154 | 182 | 209 | 222 | 227 | 231 | 235 | 238 | 241 | 243 | 246 | 253 | 258 |
| 275 | 136 | 164 | 191 | 213 | 219 | 224 | 229 | 232 | 236 | 238 | 241 | 243 | 251 | 256 |
| 300 | 146 | 174 | 201 | 211 | 217 | 222 | 226 | 230 | 233 | 236 | 239 | 241 | 249 | 254 |
| 350 | 166 | 192 | 200 | 207 | 212 | 217 | 222 | 226 | 229 | 232 | 235 | 237 | 245 | 250 |
| 400 | 181 | 190 | 197 | 203 | 209 | 214 | 218 | 222 | 225 | 228 | 231 | 233 | 241 | 247 |
| 450 | 180 | 188 | 193 | 201 | 206 | 211 | 215 | 218 | 222 | 225 | 227 | 230 | 238 | 244 |
| 500 | 179 | 186 | 193 | 198 | 203 | 208 | 212 | 215 | 219 | 222 | 224 | 227 | 235 | 241 |

| LENGTH OF LATERAL IN FEET 8" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 45 | 73 | 100 | 128 | 155 | 183 | 210 | 238 | 265 | 279 | 280 | 280 | 281 | 281 |
| 50 | 63 | 90 | 118 | 145 | 173 | 200 | 228 | 255 | 275 | 275 | 276 | 277 | 278 | 279 |
| 75 | 80 | 108 | 135 | 163 | 190 | 213 | 245 | 270 | 272 | 272 | 273 | 274 | 276 | 277 |
| 100 | 98 | 125 | 153 | 180 | 208 | 235 | 263 | 267 | 268 | 269 | 270 | 271 | 274 | 275 |
| 125 | 116 | 143 | 171 | 198 | 226 | 253 | 263 | 265 | 266 | 267 | 268 | 269 | 272 | 274 |
| 150 | 133 | 161 | 188 | 216 | 243 | 258 | 260 | 262 | 264 | 265 | 265 | 267 | 270 | 272 |
| 175 | 151 | 178 | 206 | 233 | 254 | 256 | 258 | 260 | 262 | 263 | 264 | 265 | 268 | 271 |
| 200 | 168 | 196 | 223 | 249 | 252 | 254 | 256 | 258 | 260 | 261 | 262 | 263 | 267 | 269 |
| 225 | 186 | 213 | 241 | 247 | 250 | 253 | 255 | 257 | 258 | 259 | 261 | 262 | 265 | 268 |
| 250 | 204 | 231 | 242 | 246 | 249 | 251 | 253 | 255 | 256 | 258 | 259 | 260 | 264 | 267 |
| 275 | 221 | 237 | 241 | 244 | 247 | 250 | 252 | 254 | 255 | 256 | 258 | 259 | 263 | 266 |
| 300 | 232 | 237 | 240 | 243 | 246 | 249 | 251 | 253 | 254 | 255 | 256 | 258 | 262 | 265 |
| 350 | 232 | 235 | 239 | 242 | 244 | 247 | 249 | 251 | 252 | 253 | 254 | 256 | 260 | 263 |
| 400 | 231 | 234 | 238 | 240 | 243 | 245 | 247 | 249 | 250 | 251 | 253 | 254 | 258 | 261 |
| 450 | 230 | 234 | 237 | 239 | 241 | 243 | 245 | 247 | 248 | 250 | 251 | 252 | 256 | 259 |
| 500 | 230 | 233 | 236 | 238 | 240 | 242 | 244 | 246 | 247 | 249 | 250 | 251 | 255 | 258 |

AIR TEST TABLES

12"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE
TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| LENGTH OF LATERAL IN FEET 4" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 12" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 44 | 84 | 123 | 163 | 202 | 242 | 282 | 321 | 332 | 333 | 334 | 334 | 336 | 336 |
| 50 | 48 | 88 | 128 | 167 | 207 | 246 | 286 | 323 | 324 | 326 | 327 | 328 | 331 | 333 |
| 75 | 53 | 92 | 132 | 172 | 211 | 251 | 290 | 316 | 317 | 319 | 321 | 323 | 327 | 329 |
| 100 | 57 | 97 | 136 | 176 | 216 | 255 | 295 | 308 | 311 | 313 | 316 | 317 | 323 | 326 |
| 125 | 62 | 101 | 141 | 180 | 220 | 260 | 297 | 301 | 304 | 308 | 310 | 312 | 319 | 323 |
| 150 | 66 | 106 | 145 | 185 | 224 | 264 | 290 | 295 | 299 | 302 | 305 | 308 | 315 | 319 |
| 175 | 70 | 110 | 150 | 189 | 229 | 268 | 283 | 289 | 293 | 297 | 300 | 303 | 311 | 316 |
| 200 | 75 | 114 | 154 | 194 | 233 | 271 | 277 | 283 | 288 | 292 | 296 | 299 | 308 | 313 |
| 225 | 79 | 119 | 158 | 195 | 238 | 265 | 272 | 278 | 283 | 288 | 291 | 295 | 304 | 310 |
| 250 | 84 | 123 | 163 | 202 | 242 | 259 | 267 | 273 | 278 | 283 | 287 | 291 | 301 | 308 |
| 275 | 88 | 128 | 167 | 207 | 244 | 254 | 262 | 269 | 274 | 279 | 283 | 287 | 298 | 305 |
| 300 | 92 | 132 | 172 | 211 | 239 | 249 | 257 | 264 | 270 | 275 | 279 | 283 | 295 | 302 |
| 350 | 101 | 141 | 180 | 213 | 231 | 241 | 249 | 256 | 262 | 268 | 272 | 276 | 289 | 297 |
| 400 | 110 | 150 | 189 | 210 | 223 | 233 | 242 | 249 | 255 | 261 | 266 | 270 | 283 | 292 |
| 450 | 119 | 158 | 189 | 204 | 216 | 227 | 235 | 243 | 249 | 255 | 260 | 264 | 278 | 288 |
| 500 | 128 | 166 | 184 | 198 | 210 | 221 | 229 | 237 | 243 | 249 | 254 | 259 | 273 | 283 |

| LENGTH OF LATERAL IN FEET 6" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 12" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 50 | 87 | 129 | 168 | 208 | 248 | 287 | 327 | 331 | 332 | 333 | 333 | 335 | 335 |
| 50 | 59 | 99 | 139 | 178 | 218 | 257 | 297 | 321 | 323 | 325 | 326 | 327 | 330 | 332 |
| 75 | 69 | 109 | 149 | 188 | 223 | 267 | 307 | 314 | 316 | 318 | 320 | 321 | 326 | 328 |
| 100 | 79 | 119 | 158 | 198 | 238 | 277 | 302 | 306 | 309 | 312 | 314 | 316 | 321 | 325 |
| 125 | 89 | 129 | 168 | 208 | 248 | 287 | 295 | 300 | 303 | 306 | 309 | 311 | 317 | 321 |
| 150 | 99 | 139 | 173 | 218 | 257 | 284 | 289 | 294 | 298 | 301 | 304 | 306 | 314 | 318 |
| 175 | 109 | 149 | 188 | 228 | 257 | 278 | 284 | 289 | 293 | 296 | 299 | 302 | 310 | 315 |
| 200 | 119 | 158 | 198 | 238 | 265 | 272 | 278 | 284 | 288 | 292 | 295 | 298 | 306 | 312 |
| 225 | 129 | 168 | 208 | 248 | 260 | 268 | 274 | 279 | 284 | 288 | 291 | 294 | 303 | 309 |
| 250 | 139 | 178 | 218 | 246 | 255 | 263 | 269 | 275 | 280 | 284 | 287 | 290 | 300 | 306 |
| 275 | 149 | 188 | 228 | 242 | 251 | 259 | 266 | 271 | 276 | 280 | 284 | 287 | 297 | 304 |
| 300 | 158 | 198 | 227 | 238 | 248 | 255 | 262 | 268 | 272 | 277 | 281 | 284 | 294 | 301 |
| 350 | 178 | 208 | 221 | 232 | 241 | 249 | 255 | 261 | 266 | 271 | 274 | 278 | 289 | 296 |
| 400 | 189 | 204 | 217 | 227 | 236 | 243 | 250 | 256 | 261 | 265 | 269 | 273 | 284 | 292 |
| 450 | 187 | 201 | 213 | 223 | 231 | 239 | 245 | 251 | 256 | 260 | 264 | 268 | 279 | 288 |
| 500 | 186 | 199 | 210 | 219 | 227 | 234 | 240 | 246 | 251 | 256 | 260 | 263 | 275 | 284 |

| LENGTH OF LATERAL IN FEET 8" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 12" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 57 | 97 | 136 | 176 | 216 | 255 | 295 | 331 | 332 | 333 | 334 | 334 | 336 | 336 |
| 50 | 75 | 114 | 154 | 194 | 233 | 273 | 312 | 324 | 325 | 327 | 328 | 329 | 331 | 333 |
| 75 | 92 | 132 | 172 | 211 | 251 | 290 | 315 | 317 | 319 | 321 | 323 | 324 | 327 | 330 |
| 100 | 110 | 150 | 189 | 229 | 268 | 306 | 309 | 312 | 314 | 316 | 318 | 319 | 324 | 327 |
| 125 | 128 | 167 | 207 | 246 | 286 | 300 | 303 | 306 | 309 | 311 | 314 | 315 | 320 | 324 |
| 150 | 145 | 185 | 224 | 264 | 290 | 295 | 299 | 302 | 305 | 307 | 310 | 311 | 317 | 321 |
| 175 | 163 | 202 | 242 | 279 | 285 | 290 | 294 | 298 | 301 | 304 | 306 | 308 | 314 | 318 |
| 200 | 180 | 220 | 260 | 275 | 281 | 287 | 291 | 294 | 297 | 300 | 303 | 305 | 312 | 316 |
| 225 | 198 | 238 | 265 | 272 | 278 | 283 | 287 | 291 | 294 | 297 | 300 | 302 | 309 | 314 |
| 250 | 216 | 253 | 262 | 269 | 275 | 280 | 284 | 288 | 291 | 294 | 297 | 299 | 306 | 311 |
| 275 | 233 | 251 | 260 | 266 | 272 | 277 | 282 | 285 | 289 | 292 | 294 | 297 | 304 | 309 |
| 300 | 240 | 249 | 258 | 264 | 270 | 275 | 279 | 283 | 286 | 289 | 292 | 294 | 302 | 307 |
| 350 | 238 | 247 | 254 | 260 | 266 | 271 | 275 | 279 | 282 | 285 | 288 | 290 | 298 | 304 |
| 400 | 237 | 245 | 252 | 257 | 263 | 267 | 271 | 275 | 278 | 281 | 284 | 286 | 294 | 300 |
| 450 | 236 | 243 | 249 | 255 | 260 | 264 | 268 | 272 | 275 | 278 | 281 | 283 | 291 | 297 |
| 500 | 235 | 242 | 248 | 253 | 257 | 262 | 265 | 269 | 272 | 275 | 278 | 280 | 288 | 295 |

AIR TEST TABLES

15"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE
TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| LENGTH OF LATERAL IN FEET 4" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 15" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 66 | 128 | 190 | 252 | 314 | 376 | 414 | 415 | 416 | 417 | 418 | 418 | 420 | 421 |
| 50 | 71 | 133 | 194 | 256 | 318 | 380 | 403 | 406 | 408 | 409 | 411 | 412 | 415 | 417 |
| 75 | 75 | 137 | 199 | 261 | 323 | 385 | 393 | 397 | 400 | 402 | 404 | 406 | 410 | 413 |
| 100 | 80 | 141 | 203 | 265 | 327 | 378 | 384 | 388 | 392 | 395 | 397 | 400 | 406 | 409 |
| 125 | 84 | 146 | 208 | 270 | 331 | 369 | 375 | 380 | 385 | 388 | 391 | 394 | 401 | 406 |
| 150 | 88 | 150 | 212 | 274 | 336 | 360 | 367 | 373 | 378 | 382 | 385 | 388 | 397 | 402 |
| 175 | 93 | 155 | 216 | 278 | 340 | 351 | 359 | 366 | 371 | 376 | 380 | 383 | 392 | 398 |
| 200 | 97 | 159 | 221 | 283 | 332 | 343 | 352 | 359 | 365 | 370 | 374 | 378 | 388 | 395 |
| 225 | 102 | 163 | 225 | 287 | 324 | 336 | 345 | 353 | 359 | 365 | 369 | 373 | 384 | 392 |
| 250 | 106 | 168 | 230 | 292 | 317 | 329 | 339 | 347 | 353 | 359 | 364 | 368 | 380 | 388 |
| 275 | 110 | 172 | 234 | 293 | 310 | 323 | 333 | 341 | 348 | 354 | 359 | 364 | 377 | 385 |
| 300 | 115 | 177 | 238 | 287 | 303 | 316 | 327 | 336 | 343 | 349 | 354 | 359 | 373 | 382 |
| 350 | 124 | 135 | 247 | 275 | 292 | 305 | 316 | 325 | 333 | 340 | 346 | 351 | 366 | 376 |
| 400 | 132 | 194 | 242 | 264 | 281 | 295 | 306 | 316 | 324 | 332 | 338 | 343 | 359 | 370 |
| 450 | 141 | 203 | 233 | 255 | 272 | 285 | 298 | 308 | 316 | 324 | 330 | 336 | 353 | 365 |
| 500 | 150 | 199 | 225 | 247 | 264 | 278 | 290 | 300 | 309 | 316 | 323 | 329 | 347 | 359 |

| LENGTH OF LATERAL IN FEET 6" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 15" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 72 | 134 | 196 | 257 | 319 | 381 | 411 | 413 | 414 | 416 | 416 | 417 | 419 | 420 |
| 50 | 82 | 144 | 205 | 267 | 329 | 391 | 399 | 402 | 404 | 406 | 408 | 409 | 413 | 415 |
| 75 | 92 | 154 | 215 | 277 | 339 | 383 | 388 | 392 | 395 | 398 | 400 | 402 | 408 | 411 |
| 100 | 102 | 163 | 225 | 287 | 349 | 372 | 378 | 383 | 387 | 390 | 393 | 395 | 402 | 406 |
| 125 | 111 | 173 | 235 | 297 | 352 | 362 | 369 | 374 | 379 | 383 | 386 | 389 | 397 | 402 |
| 150 | 121 | 183 | 245 | 307 | 342 | 352 | 360 | 367 | 372 | 376 | 380 | 383 | 392 | 398 |
| 175 | 131 | 193 | 255 | 317 | 334 | 344 | 353 | 360 | 365 | 370 | 374 | 377 | 387 | 394 |
| 200 | 141 | 203 | 265 | 312 | 325 | 337 | 346 | 353 | 359 | 364 | 368 | 372 | 383 | 390 |
| 225 | 151 | 213 | 275 | 304 | 319 | 330 | 339 | 346 | 353 | 358 | 363 | 367 | 379 | 387 |
| 250 | 161 | 223 | 279 | 298 | 312 | 323 | 333 | 341 | 347 | 353 | 358 | 362 | 374 | 383 |
| 275 | 171 | 233 | 273 | 292 | 306 | 317 | 327 | 335 | 342 | 348 | 353 | 357 | 370 | 379 |
| 300 | 181 | 243 | 268 | 286 | 300 | 312 | 322 | 330 | 337 | 343 | 349 | 353 | 367 | 376 |
| 350 | 201 | 237 | 259 | 277 | 291 | 302 | 312 | 321 | 328 | 334 | 339 | 344 | 359 | 370 |
| 400 | 204 | 231 | 252 | 258 | 282 | 294 | 304 | 312 | 320 | 326 | 332 | 337 | 353 | 364 |
| 450 | 201 | 226 | 245 | 261 | 275 | 286 | 296 | 305 | 312 | 319 | 325 | 330 | 346 | 358 |
| 500 | 199 | 221 | 240 | 255 | 269 | 280 | 290 | 298 | 306 | 312 | 318 | 324 | 341 | 353 |

| LENGTH OF LATERAL IN FEET 8" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 15" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 80 | 141 | 203 | 265 | 327 | 389 | 411 | 413 | 414 | 418 | 416 | 417 | 419 | 420 |
| 50 | 97 | 159 | 221 | 283 | 345 | 395 | 399 | 402 | 404 | 408 | 407 | 409 | 413 | 415 |
| 75 | 115 | 177 | 228 | 300 | 362 | 383 | 383 | 392 | 395 | 400 | 400 | 402 | 407 | 410 |
| 100 | 132 | 194 | 256 | 318 | 366 | 373 | 378 | 383 | 387 | 392 | 393 | 395 | 402 | 406 |
| 125 | 150 | 212 | 274 | 336 | 356 | 364 | 370 | 375 | 379 | 385 | 386 | 389 | 397 | 402 |
| 150 | 168 | 229 | 291 | 337 | 348 | 356 | 362 | 368 | 373 | 379 | 380 | 383 | 392 | 398 |
| 175 | 185 | 247 | 309 | 329 | 340 | 349 | 355 | 362 | 366 | 373 | 374 | 378 | 387 | 394 |
| 200 | 203 | 265 | 309 | 323 | 334 | 342 | 349 | 356 | 361 | 367 | 368 | 373 | 383 | 390 |
| 225 | 220 | 282 | 303 | 317 | 328 | 337 | 344 | 350 | 356 | 362 | 364 | 368 | 379 | 386 |
| 250 | 238 | 281 | 292 | 311 | 322 | 331 | 339 | 345 | 351 | 357 | 360 | 364 | 375 | 383 |
| 275 | 256 | 277 | 293 | 307 | 318 | 327 | 334 | 341 | 346 | 353 | 356 | 359 | 372 | 380 |
| 300 | 254 | 274 | 290 | 303 | 313 | 322 | 330 | 336 | 342 | 349 | 352 | 356 | 368 | 377 |
| 350 | 250 | 269 | 283 | 296 | 306 | 315 | 322 | 329 | 335 | 341 | 344 | 349 | 362 | 371 |
| 400 | 248 | 264 | 278 | 290 | 300 | 308 | 316 | 322 | 328 | 335 | 338 | 342 | 356 | 366 |
| 450 | 246 | 261 | 274 | 285 | 294 | 303 | 310 | 316 | 322 | 329 | 332 | 337 | 351 | 361 |
| 500 | 244 | 258 | 270 | 281 | 290 | 298 | 305 | 311 | 317 | 323 | 327 | 331 | 346 | 356 |

AIR TEST TABLES

18"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE
TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| LENGTH OF LATERAL IN FEET 4" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 18" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 94 | 183 | 272 | 361 | 450 | 496 | 498 | 499 | 501 | 502 | 502 | 503 | 505 | 506 |
| 50 | 98 | 187 | 276 | 365 | 454 | 483 | 487 | 489 | 492 | 493 | 495 | 496 | 499 | 502 |
| 75 | 102 | 191 | 281 | 370 | 459 | 470 | 476 | 480 | 483 | 485 | 488 | 489 | 494 | 497 |
| 100 | 107 | 196 | 285 | 374 | 450 | 459 | 465 | 470 | 475 | 478 | 481 | 483 | 489 | 493 |
| 125 | 111 | 200 | 289 | 378 | 438 | 448 | 456 | 462 | 467 | 470 | 474 | 477 | 484 | 489 |
| 150 | 116 | 205 | 294 | 383 | 427 | 438 | 446 | 453 | 459 | 463 | 467 | 471 | 480 | 481 |
| 175 | 120 | 209 | 298 | 387 | 416 | 428 | 438 | 445 | 452 | 457 | 461 | 465 | 475 | 481 |
| 200 | 124 | 213 | 303 | 388 | 406 | 419 | 430 | 438 | 445 | 450 | 455 | 459 | 470 | 478 |
| 225 | 129 | 218 | 307 | 378 | 397 | 410 | 422 | 431 | 438 | 444 | 449 | 453 | 466 | 474 |
| 250 | 133 | 222 | 311 | 369 | 388 | 402 | 414 | 426 | 431 | 438 | 443 | 448 | 462 | 470 |
| 275 | 138 | 227 | 316 | 360 | 380 | 395 | 407 | 417 | 425 | 432 | 438 | 443 | 457 | 467 |
| 300 | 142 | 231 | 320 | 352 | 372 | 387 | 400 | 411 | 419 | 426 | 433 | 438 | 453 | 463 |
| 350 | 151 | 240 | 308 | 337 | 358 | 374 | 388 | 399 | 408 | 416 | 422 | 428 | 445 | 457 |
| 400 | 160 | 249 | 295 | 323 | 345 | 362 | 376 | 388 | 397 | 406 | 413 | 419 | 438 | 450 |
| 450 | 168 | 246 | 283 | 312 | 333 | 351 | 365 | 378 | 388 | 396 | 404 | 411 | 430 | 444 |
| 500 | 177 | 237 | 373 | 301 | 323 | 341 | 355 | 368 | 379 | 388 | 396 | 403 | 423 | 438 |

| LENGTH OF LATERAL IN FEET 6" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 18" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 99 | 188 | 277 | 366 | 455 | 492 | 495 | 497 | 498 | 499 | 500 | 501 | 503 | 505 |
| 50 | 109 | 198 | 287 | 376 | 465 | 476 | 481 | 484 | 487 | 489 | 491 | 493 | 497 | 499 |
| 75 | 119 | 205 | 297 | 386 | 453 | 462 | 468 | 473 | 477 | 480 | 482 | 484 | 490 | 494 |
| 100 | 129 | 218 | 307 | 396 | 439 | 449 | 456 | 462 | 467 | 470 | 474 | 476 | 484 | 489 |
| 125 | 139 | 228 | 317 | 406 | 425 | 437 | 445 | 452 | 457 | 462 | 466 | 469 | 478 | 484 |
| 150 | 149 | 228 | 327 | 397 | 413 | 426 | 435 | 443 | 449 | 454 | 458 | 462 | 473 | 480 |
| 175 | 158 | 248 | 337 | 385 | 402 | 415 | 425 | 434 | 441 | 446 | 451 | 455 | 467 | 475 |
| 200 | 168 | 257 | 347 | 375 | 392 | 406 | 417 | 426 | 433 | 439 | 444 | 449 | 462 | 470 |
| 225 | 178 | 267 | 340 | 365 | 383 | 397 | 409 | 418 | 426 | 432 | 438 | 443 | 457 | 466 |
| 250 | 188 | 277 | 331 | 356 | 374 | 389 | 401 | 411 | 419 | 426 | 431 | 437 | 452 | 462 |
| 275 | 198 | 237 | 323 | 348 | 367 | 382 | 394 | 404 | 412 | 419 | 426 | 431 | 447 | 458 |
| 300 | 208 | 284 | 316 | 341 | 359 | 375 | 387 | 397 | 406 | 414 | 420 | 426 | 443 | 454 |
| 350 | 228 | 272 | 303 | 328 | 346 | 362 | 375 | 385 | 395 | 403 | 409 | 415 | 434 | 446 |
| 400 | 224 | 263 | 293 | 316 | 335 | 351 | 364 | 375 | 384 | 392 | 400 | 406 | 426 | 439 |
| 450 | 219 | 255 | 284 | 307 | 325 | 341 | 354 | 365 | 375 | 383 | 391 | 397 | 418 | 432 |
| 500 | 215 | 246 | 276 | 298 | 316 | 332 | 345 | 356 | 366 | 375 | 382 | 389 | 411 | 426 |

| LENGTH OF LATERAL IN FEET 8" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 18" DIAMETER | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
| 25 | 107 | 196 | 235 | 374 | 463 | 490 | 493 | 495 | 497 | 498 | 499 | 500 | 503 | 504 |
| 50 | 124 | 213 | 303 | 392 | 468 | 473 | 478 | 482 | 483 | 487 | 489 | 491 | 495 | 498 |
| 75 | 142 | 231 | 320 | 409 | 451 | 458 | 465 | 469 | 474 | 477 | 479 | 482 | 488 | 492 |
| 100 | 160 | 249 | 338 | 423 | 436 | 445 | 452 | 453 | 463 | 467 | 470 | 473 | 482 | 487 |
| 125 | 177 | 266 | 355 | 409 | 423 | 433 | 442 | 448 | 454 | 458 | 462 | 466 | 475 | 482 |
| 150 | 195 | 284 | 373 | 397 | 411 | 422 | 432 | 439 | 445 | 450 | 454 | 458 | 469 | 477 |
| 175 | 212 | 301 | 366 | 386 | 401 | 413 | 422 | 430 | 437 | 442 | 447 | 451 | 464 | 472 |
| 200 | 230 | 319 | 356 | 377 | 391 | 404 | 414 | 422 | 429 | 433 | 440 | 445 | 458 | 467 |
| 225 | 248 | 321 | 348 | 368 | 384 | 396 | 406 | 415 | 422 | 429 | 434 | 439 | 453 | 463 |
| 250 | 265 | 325 | 341 | 361 | 376 | 389 | 399 | 403 | 416 | 423 | 423 | 433 | 448 | 458 |
| 275 | 275 | 309 | 334 | 354 | 369 | 382 | 393 | 402 | 410 | 417 | 422 | 428 | 443 | 454 |
| 300 | 271 | 304 | 325 | 348 | 363 | 376 | 387 | 396 | 404 | 411 | 417 | 422 | 439 | 450 |
| 350 | 266 | 296 | 319 | 337 | 352 | 365 | 375 | 385 | 394 | 401 | 407 | 413 | 430 | 443 |
| 400 | 252 | 259 | 311 | 329 | 343 | 356 | 367 | 376 | 384 | 392 | 398 | 404 | 422 | 436 |
| 450 | 258 | 284 | 304 | 321 | 335 | 348 | 359 | 363 | 376 | 384 | 390 | 396 | 415 | 429 |
| 500 | 255 | 279 | 298 | 315 | 328 | 340 | 351 | 361 | 369 | 376 | 383 | 389 | 409 | 423 |

AIR TEST TABLES

21"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE
TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| LENGTH OF LATERAL IN FEET | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 21" DIAMETER | | | | |
|---------------------------|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|--|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 | |
| 25 | 126 | 247 | 368 | 490 | 577 | 581 | 582 | 584 | 585 | 586 | 587 | 588 | 590 | 591 | |
| 50 | 130 | 251 | 373 | 494 | 561 | 567 | 570 | 573 | 576 | 578 | 579 | 581 | 584 | 586 | |
| 75 | 135 | 256 | 377 | 498 | 545 | 553 | 559 | 563 | 567 | 569 | 571 | 574 | 579 | 582 | |
| 100 | 139 | 260 | 381 | 503 | 531 | 541 | 548 | 553 | 558 | 561 | 564 | 567 | 573 | 578 | |
| 125 | 143 | 265 | 386 | 503 | 518 | 529 | 537 | 544 | 549 | 553 | 557 | 560 | 568 | 573 | |
| 150 | 148 | 269 | 390 | 488 | 505 | 518 | 527 | 535 | 541 | 546 | 550 | 553 | 563 | 569 | |
| 175 | 152 | 273 | 395 | 475 | 493 | 507 | 518 | 526 | 533 | 538 | 543 | 547 | 558 | 565 | |
| 200 | 157 | 278 | 399 | 462 | 482 | 497 | 509 | 518 | 526 | 531 | 536 | 541 | 553 | 561 | |
| 225 | 161 | 282 | 403 | 450 | 472 | 488 | 500 | 510 | 518 | 524 | 530 | 535 | 548 | 557 | |
| 250 | 165 | 287 | 408 | 439 | 462 | 479 | 492 | 502 | 511 | 518 | 524 | 529 | 544 | 553 | |
| 275 | 170 | 291 | 397 | 429 | 452 | 470 | 484 | 495 | 504 | 511 | 518 | 523 | 539 | 549 | |
| 300 | 174 | 295 | 387 | 420 | 443 | 462 | 476 | 488 | 498 | 505 | 512 | 518 | 535 | 546 | |
| 350 | 183 | 304 | 368 | 402 | 427 | 446 | 462 | 474 | 485 | 493 | 501 | 507 | 526 | 538 | |
| 400 | 192 | 304 | 352 | 386 | 412 | 432 | 448 | 462 | 473 | 482 | 490 | 497 | 518 | 531 | |
| 450 | 201 | 291 | 338 | 372 | 398 | 419 | 436 | 450 | 462 | 472 | 480 | 488 | 510 | 524 | |
| 500 | 209 | 279 | 325 | 360 | 386 | 407 | 425 | 439 | 452 | 462 | 471 | 479 | 502 | 518 | |

| LENGTH OF LATERAL IN FEET | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 21" DIAMETER | | | | |
|---------------------------|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|--|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 | |
| 25 | 131 | 253 | 374 | 495 | 572 | 576 | 579 | 581 | 582 | 584 | 585 | 586 | 588 | 589 | |
| 50 | 141 | 262 | 384 | 505 | 552 | 559 | 563 | 567 | 570 | 573 | 574 | 575 | 581 | 584 | |
| 75 | 131 | 272 | 394 | 515 | 533 | 543 | 549 | 554 | 559 | 562 | 565 | 567 | 574 | 578 | |
| 100 | 161 | 282 | 403 | 501 | 516 | 528 | 536 | 542 | 548 | 552 | 555 | 559 | 567 | 572 | |
| 125 | 171 | 292 | 413 | 483 | 501 | 514 | 524 | 531 | 537 | 542 | 547 | 550 | 561 | 567 | |
| 150 | 181 | 302 | 423 | 468 | 487 | 501 | 512 | 521 | 528 | 533 | 538 | 543 | 554 | 562 | |
| 175 | 191 | 312 | 425 | 454 | 474 | 490 | 501 | 511 | 518 | 525 | 530 | 535 | 548 | 557 | |
| 200 | 201 | 322 | 412 | 441 | 462 | 479 | 491 | 501 | 510 | 517 | 522 | 528 | 542 | 552 | |
| 225 | 210 | 332 | 399 | 429 | 451 | 468 | 482 | 492 | 501 | 509 | 515 | 521 | 537 | 547 | |
| 250 | 220 | 342 | 388 | 418 | 441 | 459 | 473 | 484 | 493 | 501 | 508 | 514 | 531 | 542 | |
| 275 | 230 | 336 | 378 | 409 | 432 | 450 | 464 | 476 | 486 | 494 | 501 | 508 | 526 | 538 | |
| 300 | 240 | 327 | 369 | 399 | 423 | 441 | 456 | 468 | 479 | 487 | 495 | 501 | 521 | 533 | |
| 350 | 255 | 312 | 353 | 383 | 407 | 426 | 441 | 454 | 465 | 474 | 482 | 490 | 511 | 525 | |
| 400 | 246 | 300 | 339 | 369 | 393 | 412 | 428 | 441 | 453 | 462 | 471 | 479 | 501 | 517 | |
| 450 | 239 | 290 | 327 | 357 | 380 | 400 | 416 | 429 | 441 | 451 | 460 | 468 | 492 | 509 | |
| 500 | 234 | 281 | 317 | 346 | 369 | 389 | 405 | 419 | 431 | 441 | 450 | 439 | 484 | 501 | |

| LENGTH OF LATERAL IN FEET | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 21" DIAMETER | | | | |
|---------------------------|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|--|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 | |
| 25 | 139 | 260 | 381 | 503 | 569 | 573 | 576 | 578 | 580 | 582 | 583 | 584 | 587 | 588 | |
| 50 | 157 | 278 | 399 | 520 | 546 | 554 | 559 | 563 | 566 | 569 | 571 | 573 | 579 | 582 | |
| 75 | 176 | 295 | 417 | 513 | 526 | 536 | 543 | 549 | 554 | 557 | 560 | 563 | 571 | 575 | |
| 100 | 192 | 313 | 434 | 493 | 508 | 520 | 529 | 536 | 542 | 546 | 550 | 554 | 563 | 569 | |
| 125 | 209 | 331 | 452 | 476 | 493 | 506 | 516 | 524 | 531 | 536 | 540 | 545 | 556 | 563 | |
| 150 | 227 | 348 | 436 | 461 | 479 | 493 | 504 | 513 | 520 | 526 | 531 | 536 | 549 | 557 | |
| 175 | 245 | 366 | 422 | 447 | 466 | 481 | 493 | 502 | 511 | 517 | 523 | 528 | 542 | 552 | |
| 200 | 262 | 375 | 409 | 435 | 455 | 470 | 483 | 493 | 502 | 509 | 515 | 520 | 536 | 546 | |
| 225 | 280 | 364 | 398 | 424 | 444 | 461 | 473 | 484 | 493 | 501 | 507 | 513 | 530 | 541 | |
| 250 | 297 | 355 | 389 | 415 | 435 | 451 | 465 | 476 | 485 | 493 | 500 | 506 | 524 | 536 | |
| 275 | 298 | 347 | 380 | 406 | 425 | 443 | 456 | 468 | 478 | 486 | 493 | 499 | 518 | 531 | |
| 300 | 293 | 340 | 372 | 398 | 412 | 435 | 449 | 460 | 470 | 479 | 486 | 493 | 513 | 525 | |
| 350 | 285 | 328 | 359 | 384 | 404 | 421 | 435 | 447 | 458 | 466 | 474 | 481 | 503 | 517 | |
| 400 | 279 | 319 | 348 | 372 | 392 | 409 | 423 | 435 | 446 | 455 | 463 | 471 | 493 | 509 | |
| 450 | 274 | 311 | 338 | 362 | 381 | 398 | 413 | 425 | 435 | 445 | 453 | 481 | 484 | 501 | |
| 500 | 270 | 304 | 330 | 353 | 372 | 389 | 403 | 415 | 426 | 436 | 444 | 452 | 476 | 493 | |

AIR TEST TABLES

24"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE
TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| LENGTH OF LATERAL IN FEET 4" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 24" DIAMETER | | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|--|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 | |
| 25 | 163 | 321 | 480 | 638 | 662 | 665 | 667 | 669 | 670 | 671 | 672 | 673 | 674 | 676 | |
| 50 | 167 | 326 | 484 | 637 | 645 | 650 | 654 | 658 | 660 | 662 | 664 | 665 | 669 | 671 | |
| 75 | 172 | 330 | 488 | 617 | 629 | 636 | 642 | 647 | 650 | 653 | 656 | 658 | 663 | 666 | |
| 100 | 176 | 334 | 493 | 599 | 613 | 623 | 631 | 637 | 641 | 645 | 648 | 650 | 658 | 662 | |
| 125 | 180 | 339 | 497 | 582 | 599 | 611 | 620 | 627 | 632 | 637 | 640 | 643 | 652 | 658 | |
| 150 | 185 | 343 | 502 | 567 | 585 | 599 | 609 | 617 | 623 | 629 | 633 | 636 | 647 | 653 | |
| 175 | 189 | 348 | 506 | 552 | 573 | 588 | 599 | 608 | 615 | 621 | 626 | 630 | 642 | 649 | |
| 200 | 194 | 352 | 506 | 538 | 560 | 577 | 589 | 599 | 607 | 613 | 619 | 623 | 637 | 645 | |
| 225 | 198 | 356 | 492 | 525 | 549 | 566 | 580 | 591 | 599 | 606 | 612 | 617 | 632 | 641 | |
| 250 | 202 | 361 | 478 | 513 | 538 | 556 | 571 | 582 | 591 | 599 | 605 | 611 | 627 | 637 | |
| 275 | 207 | 365 | 465 | 501 | 528 | 547 | 562 | 574 | 584 | 592 | 599 | 606 | 622 | 633 | |
| 300 | 211 | 370 | 454 | 491 | 518 | 538 | 554 | 567 | 577 | 585 | 593 | 599 | 617 | 629 | |
| 350 | 220 | 375 | 432 | 471 | 499 | 521 | 538 | 552 | 563 | 573 | 581 | 588 | 608 | 621 | |
| 400 | 229 | 356 | 413 | 433 | 482 | 505 | 523 | 538 | 550 | 560 | 569 | 577 | 599 | 613 | |
| 450 | 238 | 340 | 397 | 436 | 467 | 491 | 509 | 525 | 538 | 549 | 558 | 566 | 590 | 606 | |
| 500 | 244 | 326 | 382 | 422 | 453 | 477 | 497 | 513 | 526 | 538 | 548 | 556 | 582 | 599 | |

| LENGTH OF LATERAL IN FEET 6" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 24" DIAMETER | | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|--|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 | |
| 25 | 126 | 327 | 485 | 644 | 656 | 660 | 663 | 665 | 667 | 668 | 669 | 670 | 673 | 674 | |
| 50 | 178 | 337 | 495 | 624 | 634 | 641 | 646 | 651 | 654 | 656 | 658 | 660 | 665 | 668 | |
| 75 | 188 | 347 | 505 | 600 | 614 | 624 | 631 | 637 | 641 | 645 | 648 | 650 | 658 | 662 | |
| 100 | 198 | 356 | 515 | 579 | 596 | 608 | 617 | 624 | 630 | 634 | 638 | 641 | 650 | 656 | |
| 125 | 208 | 366 | 525 | 559 | 579 | 593 | 603 | 612 | 618 | 624 | 629 | 632 | 644 | 651 | |
| 150 | 218 | 376 | 511 | 542 | 563 | 579 | 591 | 600 | 608 | 614 | 619 | 624 | 637 | 645 | |
| 175 | 228 | 386 | 493 | 526 | 548 | 566 | 579 | 589 | 598 | 605 | 611 | 616 | 630 | 640 | |
| 200 | 238 | 396 | 477 | 511 | 535 | 553 | 567 | 579 | 588 | 596 | 602 | 608 | 624 | 634 | |
| 225 | 248 | 406 | 462 | 497 | 522 | 542 | 557 | 569 | 579 | 587 | 594 | 600 | 618 | 629 | |
| 250 | 257 | 397 | 449 | 485 | 511 | 531 | 547 | 559 | 570 | 579 | 586 | 593 | 612 | 624 | |
| 275 | 267 | 385 | 437 | 473 | 500 | 521 | 537 | 550 | 561 | 571 | 579 | 586 | 606 | 619 | |
| 300 | 277 | 374 | 426 | 462 | 490 | 511 | 528 | 542 | 553 | 563 | 571 | 579 | 600 | 614 | |
| 350 | 283 | 356 | 406 | 443 | 471 | 493 | 511 | 526 | 538 | 549 | 558 | 566 | 589 | 605 | |
| 400 | 272 | 340 | 389 | 426 | 454 | 477 | 495 | 511 | 524 | 535 | 545 | 553 | 579 | 596 | |
| 263 | 263 | 327 | 375 | 411 | 439 | 462 | 481 | 497 | 511 | 523 | 533 | 542 | 569 | 587 | |
| 500 | 255 | 316 | 362 | 398 | 426 | 449 | 468 | 485 | 499 | 511 | 521 | 531 | 559 | 579 | |

| LENGTH OF LATERAL IN FEET 8" DIAMETER | LENGTH OF MAIN LINE IN FEET | | | | | | | | | | 24" DIAMETER | | | | |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|-----|-----|-----|--|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 | |
| 25 | 176 | 334 | 493 | 645 | 652 | 656 | 659 | 662 | 664 | 666 | 667 | 668 | 671 | 673 | |
| 50 | 194 | 352 | 510 | 615 | 627 | 633 | 641 | 645 | 649 | 652 | 654 | 636 | 662 | 666 | |
| 75 | 211 | 370 | 528 | 589 | 604 | 615 | 623 | 630 | 635 | 639 | 642 | 645 | 653 | 659 | |
| 100 | 229 | 387 | 541 | 566 | 584 | 597 | 607 | 615 | 622 | 627 | 631 | 635 | 645 | 652 | |
| 125 | 246 | 405 | 519 | 546 | 566 | 581 | 592 | 602 | 609 | 615 | 620 | 625 | 637 | 645 | |
| 150 | 264 | 422 | 499 | 528 | 550 | 566 | 579 | 589 | 597 | 604 | 610 | 615 | 630 | 639 | |
| 175 | 282 | 436 | 482 | 512 | 535 | 553 | 566 | 577 | 586 | 594 | 600 | 606 | 622 | 633 | |
| 200 | 299 | 421 | 467 | 498 | 522 | 540 | 554 | 566 | 576 | 584 | 591 | 597 | 615 | 627 | |
| 225 | 317 | 408 | 453 | 485 | 509 | 528 | 543 | 556 | 566 | 575 | 583 | 589 | 608 | 621 | |
| 250 | 331 | 396 | 441 | 473 | 498 | 517 | 533 | 546 | 557 | 566 | 574 | 581 | 602 | 615 | |
| 275 | 324 | 386 | 430 | 462 | 487 | 507 | 523 | 537 | 548 | 558 | 566 | 573 | 595 | 610 | |
| 300 | 317 | 377 | 421 | 452 | 478 | 498 | 514 | 528 | 540 | 550 | 559 | 566 | 589 | 604 | |
| 350 | 307 | 362 | 404 | 435 | 460 | 481 | 498 | 513 | 525 | 535 | 544 | 553 | 577 | 594 | |
| 400 | 298 | 350 | 390 | 420 | 445 | 466 | 483 | 498 | 511 | 522 | 532 | 540 | 566 | 584 | |
| 450 | 292 | 340 | 378 | 407 | 432 | 453 | 470 | 485 | 498 | 510 | 520 | 529 | 536 | 575 | |
| 500 | 286 | 331 | 367 | 396 | 471 | 441 | 459 | 474 | 487 | 498 | 509 | 518 | 547 | 567 | |

AIR TEST TABLES

27"-30"-33"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| | | PIPE DIAMETER | | | | | | | | | | | | |
|------------------------|-----|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| | | 4" | 6" | 8" | 10" | 12" | 15" | 18" | 21" | 24" | 27" | 30" | 33" | |
| LENGTH OF LINE IN FEET | 25 | 4 | 10 | 18 | 28 | 40 | 62 | 89 | 121 | 158 | 200 | 248 | 299 | |
| | 50 | 9 | 20 | 35 | 55 | 79 | 124 | 17 | 243 | 317 | 401 | 495 | 599 | |
| | 75 | 13 | 30 | 53 | 83 | 119 | 186 | 267 | 364 | 475 | 601 | 743 | 898 | |
| | 100 | 18 | 40 | 70 | 110 | 158 | 248 | 356 | 485 | 634 | 765 | 851 | 935 | |
| | | | | | | | | | | | | | | |
| | 125 | 22 | 50 | 88 | 138 | 198 | 309 | 446 | 595 | 680 | | | | |
| | 150 | 26 | 59 | 106 | 165 | 238 | 371 | 510 | | | | | | |
| | 175 | 31 | 69 | 123 | 193 | 277 | 425 | | | | | | | |
| | 200 | 35 | 79 | 141 | 220 | 317 | | | | | | | | |
| | | | | | | | | | | | | | | |
| | 225 | 40 | 89 | 158 | 248 | 340 | | | | | | | | |
| | 250 | 44 | 99 | 176 | 275 | | | | | | | | | |
| | 275 | 48 | 109 | 194 | 283 | | | | | | | | | |
| | 300 | 53 | 119 | 211 | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | 350 | 62 | 139 | 227 | | | | | | | | | | |
| | 400 | 70 | 158 | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | 450 | 79 | 170 | | | | | | | | | | | |
| | 500 | 88 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 550 | 97 | | | | | | | | | | | | | |
| 600 | 106 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 650 | 113 | 170 | 227 | 283 | 340 | 425 | 510 | 595 | 680 | 765 | 851 | 935 | | |

NOTE: TO BE USED WHEN TESTING ONE DIAMETER ONLY

AIR TEST TABLES
 MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
 PRESSURE TO DROP FROM 3-1/2 TO 2-1/2 PSIG

| | | PIPE DIAMETER | | | | | | | | | | | | | | |
|------------------------|-----|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|--|
| | | 4" | 6" | 8" | 10" | 12" | 15" | 18" | 21" | 24" | 27" | 30" | 33" | 36" | 39" | |
| LENGTH OF LINE IN FEET | 25 | 40 | 10 | 18 | 28 | 40 | 62 | 89 | 121 | 158 | 200 | 248 | 299 | 356 | | |
| | 50 | 90 | 20 | 35 | 55 | 79 | 124 | 178 | 243 | 317 | 401 | 495 | 599 | 713 | | |
| | 75 | 13 | 30 | 53 | 83 | 119 | 186 | 267 | 364 | 475 | 601 | 743 | 898 | 1020 | | |
| | 100 | 18 | 40 | 70 | 110 | 158 | 248 | 356 | 485 | 634 | 765 | 851 | 935 | | | |
| | | | | | | | | | | | | | | | | |
| | 125 | 22 | 50 | 88 | 138 | 198 | 309 | 446 | 595 | 680 | | | | | | |
| | 150 | 26 | 59 | 106 | 165 | 238 | 371 | 510 | | | | | | | | |
| | 175 | 31 | 69 | 123 | 193 | 277 | 425 | | | | | | | | | |
| | 200 | 35 | 79 | 141 | 220 | 317 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | 225 | 40 | 89 | 158 | 248 | 340 | | | | | | | | | | |
| | 250 | 44 | 99 | 179 | 275 | | | | | | | | | | | |
| | 275 | 48 | 109 | 194 | 283 | | | | | | | | | | | |
| | 300 | 53 | 119 | 211 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | 350 | 62 | 139 | 227 | | | | | | | | | | | | |
| | 400 | 70 | 158 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | 450 | 79 | 170 | | | | | | | | | | | | | |
| | 500 | 88 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 550 | 97 | | | | | | | | | | | | | | | |
| 600 | 106 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 650 | 113 | 170 | 227 | 283 | 340 | 425 | 510 | 595 | 680 | 765 | 851 | 935 | 1020 | | | |

NOTE: TO BE USED WHEN TESTING ONE DIAMETER ONLY

AIR TEST TABLES

36" - 108"

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3-1/2 TO 2-1/2 PISG

| LENGTH OF LINE IN FEET | 36" | 39" | 42" | 48" | 54" | 60" | 66" | 72" | 78" | 84" | 90" | 96" |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 25 | 356 | 418 | 485 | 634 | 802 | 990 | 1198 | 1425 | 1673 | 1940 | 2228 |
| 50 | 713 | 837 | 970 | 1268 | 1528 | 1698 | 1868 | 2038 | 2207 | 2372 | 2547 | 2717 |
| 75 | 1020 | 1105 | 1189 | 1358 | | | | | | | | |
| 100 | | | | | | | | | | | | |
| 125 | | | | | | | | | | | | |
| 150 | | | | | | | | | | | | |
| 175 | | | | | | | | | | | | |
| 200 | | | | | | | | | | | | |
| 225 | | | | | | | | | | | | |
| 250 | | | | | | | | | | | | |
| 275 | | | | | | | | | | | | |
| 300 | | | | | | | | | | | | |
| 350 | | | | | | | | | | | | |
| 400 | | | | | | | | | | | | |
| 450 | | | | | | | | | | | | |
| 500 | | | | | | | | | | | | |
| 550 | | | | | | | | | | | | |
| 600 | | | | | | | | | | | | |
| 650 | 1020 | 1105 | 1189 | 1358 | 1528 | 1698 | 1868 | 2038 | 2207 | 2372 | 2547 | 2717 |

NOTE: TO BE USED WHEN TESTING ONE DIAMETER ONLY

| LENGTH OF LINE IN FEET | 102" | 108" |
|------------------------|------|------|
| 25 | 2861 | 3056 |
| 50 | 2887 | |
| 650 | 2887 | 3056 |

2. Sanitary Sewer Field Tests

Sanitary sewers shall be tested under low air pressures listed on the following tables after completion of backfill and approval of the compaction. Inspect sewers and manholes prior to testing and eliminate discernible water leaks and debris. The Contractor may perform preliminary tests at his own discretion for his information, without the presence of the Engineer, at no cost to the City. The Contractor shall schedule the proposed tests with the Engineer at least 48 hours in advance. Tests shall be performed in the presence of the Engineer or his duly authorized representative. Pressure gauges and stop watches will be furnished by the Engineer. All other material, equipment and labor required shall be provided by the Contractor. Test sewers from manhole to manhole or from manhole to terminus.

Conduct tests as follows: Provide tests plugs at each manhole, securely braced. Provide suitable means of determining depth of groundwater level above the inverts immediately before testing. The engineer will increase gauge pressures accordingly. Add air slowly to the portion of the pipe being tested until internal air pressure is at a test pressure of 4 psi above the invert or above the groundwater table, whichever is greater, or pressure equal to the hydraulic gradient, whichever is greater. Do not allow personnel in manholes after increasing air pressure. If, in the engineer's opinion, there is any indication of leakage at the test plug, relieve the pressure before taking steps to eliminate the leak. Maintain test pressure for a minimum of two minutes, then disconnect hose and compressor. If pressure decreases to 3.5 psi, record the time required for the pressure to drop one psi from 3.5 to 2.5 psi. Pipes failing to maintain minimum acceptable holding times set forth in the tables included herein will not be accepted. Make repairs or replacement as required at no cost to the City and retest as specified herein.

TV inspections to identify deficiencies including blockages, sags, cracks, incorrect fittings, etc. will be conducted by the City for all public sewer during the following phases of construction;

- **Inspection of the sewer main lines and all laterals prior to the placement of base paving (Base Phase)**
- **Inspection of the sewer laterals from the clean-out to the main line, including dumping water into the lateral to check for sags, prior to issuance of certificate of occupancy (C/O Phase)**
- **Inspection of the sewer main lines prior to placement of top coat of paving and final acceptance. This phase will inspect for blockages and major defects in the main including cracks, busted pipe, blockages, or sags holding greater than ½ inch of water.**

The aforementioned inspections (1 per Phase) are included under the Grading/Public Improvements Permit inspection fees. The contractor will be required to correct any and all defects at the contractor's expense and subsequent reinspections will be required until all defects have been corrected.

Sewer lines and manholes are required to be clean (jet sprayed by the contractor, if necessary) prior to TV inspection. Any sewer line found to be dirty (mud, gravel, obstructions, etc.) during the TV inspection process must be cleaned by the contractor prior to re-inspection by the City.

Any reinspections shall require the payment of a reinspection fee at the current rate as adopted by the Mayor and Board of Aldermen. For City contracts, the cost of additional tests and reinspections will be deducted from the monies owed the Contractor.

3. Pressure Tests for Force Mains

The Contractor shall provide equipment for and conduct pressure tests under pressures indicated on the plans. Pressure recorder, charts and water meter for testing will be furnished by the City. Set up testing equipment in accordance with the Standard Detail for testing watermains. Tests conducted on ductile iron pipe shall meet requirements of AWWA C-600. Tests conducted on concrete pipe shall meet requirements of AWWA C-600, modified as per AWWA Manual M II.

Test pipe after completion of backfill operations in lengths directed by the engineer. Close ends of test sections with valves or plugs, where possible, or provide test plugs.

Fill the length of the force main under test with water and subject it to the maximum sustained internal pressure plus water hammer at the low point as indicated in the Contract Documents. Maintain pressure for a minimum of two hours. City personnel will operate all valves in the test section during this portion of the test.

Should test results show any visible leakage, displacement or damage, the Contractor shall repair the leakage, displacement or damage and retest until specified conditions are met, to the satisfaction of the engineer, at no cost to the City.

The maximum allowable leakage shall be determined from the following formula:

$$L = \frac{NDP}{3700}$$

L = allowable leakage in gallons per hour

N = number of joints in length of pipe tested

D = nominal diameter of pipe in inches

P = average test pressure during the test in psi

4. Inspection and Testing of Pipe

The engineer may inspect and test all pipe, fittings and joint material upon delivery to the site or at the factory. The pipe manufacturer or supplier shall furnish materials to be tested and labor as required to assist the engineer with the tests.

Manufacturer or supplier shall provide ample space between rows of stockpiled pipe to facilitate adequate inspection.

The pipe manufacturer or supplier shall provide the City Materials Inspector, prior to commencing the inspection of pipe for an order with the complete City contract number, contractor's name, the pipe diameters, classes and designs and footage of pipe needed to fill the order.

The pipe manufacturer or supplier shall provide evidence to the City Materials Inspector, prior to inspection, that there is an adequate quantity of pipe available of the required diameters, classes and designs for inspection.

The pipe manufacturer or supplier shall provide facilities for conducting load-bearing test.

The pipe manufacturer or supplier shall provide competent personnel for the preparation and conducting of hydrostatic and load bearing tests. The City Materials Inspector has the right to be present during all phases of testing.

For reinforced concrete pipe furnished under this Section, provide test specimens, selected at random from production pipe, to the City Materials Inspector.

Provide up to 1/2 of one percent of the number of pipes to be furnished for each size, but no less than two test specimens for each size and class for the load bearing test. Where hydrostatic tests are required, conduct such tests concomitant with the load bearing tests, using two pieces of pipe jointed together, of the same size, class and production run, load bearing test specimens will not be accepted for incorporation into the work.

Precast concrete manhole requirements are specified in Section 02700.

5. Deflection Test, PVC Pipe:

At any time beyond thirty (30) days after final backfill of the trench and prior to the expiration of one (1) year the sewer lines shall be checked for deflection. Vertical deflection tests shall be performed on all of the PVC pipe installed. The Contractor shall conduct the tests under the observation of the Engineer and shall furnish all test equipment and labor for conducting the tests. Deflections of five percent (5%) or greater of the inside pipe diameter shall be considered unacceptable and such pipe shall be replaced by the Contractor at his expense. The deflection shall

be checked by pulling a cylinder, sphere, or measuring device through the pipe.

C. Submittals

Submit shop drawings labeled with the City Contract Number, Contractor's name, project name and location, title, drawing number, revision number and date of drawing and revisions for the following:

Nonreinforced concrete pipe; show strength, joint and gasket dimensions, and conformance to pertinent ASTM Specifications.

Reinforced concrete pipe; show strength, details of special fittings, reinforcing dimensions and details and joint and gasket dimensions.

For pipe designated in the Plans by D loads, furnish calculations signed by a Professional Engineer registered in the State of Maryland, or an officer, or a duly authorized representative of the pipe designs required by ASTM C655.

Furnish laying schedules for all curved and beveled pipe and where indicated.

Joint openings specified in the laying schedule for sanitary sewers shall not exceed one half inch.

Limit bevels to 4 –1/2 degrees for all beveled pipe.

Precast concrete manholes are specified in Section 02720.

Shop drawing requirements for concrete pipe and manholes will be materials furnished under this Section. Certifications shall include City contract number, job location, contractor's name, types, classes and strengths of pipe, and pipe manufacturer.

Submit certified tests reports before delivery of materials for all materials furnished under this Section. Certifications shall include City contract number, job location, contractor's name, types, classes and strengths of pipe, and pipe manufacturer.

At the option of the Engineer, the Contractor shall, in addition to or in lieu of the above specified certified tests reports, furnish certificates of compliance from the manufacturer.

A packing list or invoice shall accompany every shipment and shall contain the following information: City contract number, kind and class of pipe, length and other pertinent information.

Alternate precast concrete structures.

The Contractor may, at his option, provide precast concrete structures in lieu of the cast-in-place concrete or masonry structures shown on the Standard Details on the Plans. Precast manholes and inlets to be indicated on standard drawings.

Submit working drawings including calculations, design loads, materials, strengths and sizes and thicknesses.

D. Test Criteria

Cast iron soil pipe shall withstand pressures as set forth in the applicable referenced specifications referred to herein.

All other pipe for sewers shall withstand internal hydrostatic pressure of ten psi (10) for ten minutes with no leakage. Moisture appearing in the form of patches or beads which results in runs on pipe walls will not be considered as leakage, provided the pipe walls appear dry upon retesting at the prescribed test pressure after elapse of maximum 24 hours. Do not apply pressure during the period between the test and the retest. Provide hydrostatic tests for reinforced concrete pipe for sewers in accordance with ASTM C497.

Acceptance of reinforced concrete pipe will be based on the Plant Load-Bearing Tests, Materials Tests and Inspection of Manufactured Pipe for Visual Defects and Imperfections and stipulations as set forth in appropriate ASTM specification and modified herein.

Polyvinyl chloride (PVC) pipe 6 inches through 15 inches in diameter shall conform to the requirements of ASTM D3034 and referenced ASTM documents.

Delete all referenced to agreements between seller and purchaser on the referenced ASTM Standard.

Criteria for sampling, inspection shall be specified in Paragraph I.B.3. Criteria for retest and rejection shall be as specified below:

Retest and Rejection:

Upon failure of any specimen tested to meet requirements set forth herein and in the referenced ASTM documents, the City Materials Inspector will randomly select and test two additional samples from the same production run of the pipe originally tested.

Failure of either of these two additional samples to meet the referenced requirements shall be cause for rejection of the remainder of that production run.

2. Materials

A. Contractor's Options

For house connections, furnish either PVC pipe or cast iron soil pipe, service weight of the size indicated.

House connection renewals, including drop connections, shall be 4 or 6 inch PVC or cast iron soil pipe.

For main line sewers less than 15 inches in diameter, unless otherwise indicated, furnish either PVC pipe, thickness classification SDR-26 or concrete sewer pipes extra strength.

For main line sewers 15 inches in diameter and larger, furnish either PVC pipe meeting requirements of ASTM F 679 and Reference Standards or reinforced concrete pipe, class as indicated.

Prestressed concrete pipe and fittings may be supplied in lieu of reinforced concrete pipe provided it meets design, quality control and test requirements of ASTM C76 as modified and supplemented herein.

B. Materials Requirements

1. Pipe and Fittings

General – All pipe and fittings between structures or between structure and terminus shall be of the same size and material and shall be furnished by the same manufacturer. Each pipe length shall be clearly marked at intervals of five feet maximum with the manufacturer's name or trademark, pipe size, PVC cell classification, appropriate legend such as SDR-26 PVC Sewer Pipe, ASTM D3034, manufacturer's lot number, date of manufacture and point of origin. Pipe not marked as indicated herein may be rejected.

Polyvinyl chloride pipe and fittings shall meet ASTM Standard D3034 in sizes 4 inch through 15 inch and ASTM F679 in sizes 18 inch through 27 inch, except as modified herein. Joints for PVC pipe and fittings shall conform to ASTM D3212 and Reference Standards.

Fittings shall have SDR-26 minimum wall thickness for sewer main fittings and SDR-26 or SDR-35 for cleanout connection fittings as shown on Detail SS-2. Fittings in sizes 4 inch through 8 inch shall be molded in one piece with minimum socket depth as specified in Section 7.3.2 of ASTM D3034 and a gasket cross sectional area minimum of 0.20 square inches. Fittings 10 inches and larger shall conform to Section 7.22 of ASTM D3034.

Pipe with blisters, bubbles, cuts or scrapes on inside or outside surfaces, which appreciably damage the wall thickness, or other imperfections which impair the performance or life of the pipe, may be rejected.

Cast iron soil pipe and fittings shall meet requirements of ASTM A74, service weight, furnished in five and ten foot lengths, single or double hub as required. Hydrostatic tests will not be required. Joints shall be lead or neoprene compression gaskets, TySeal of Tyler Pipe, Dual-Tyte of Charlotte Foundry or equal. Provide plain beveled end with centering recess in the hub for use with gasket joint.

Circular reinforced concrete pipe and fittings shall meet requirements of ASTM C76 as modified herein.

Pipe shall be substantially free from surface roughness. The interior walls shall be substantially a smooth surface and be free from noticeable and harmful ridges, corrugations, elevations and depressions. The finished surface shall also be free of any material which is not an integral part of the compacted concrete, such as loose aggregate, cementitious slurry coats, silts, cement and non-required markings.

Pipe shall be tested to the 0.01-inch crack and to the specified ultimate load.

In pipes with belled ends, extend longitudinal steel so as to form supports for holding circumferential steel in place, and so form as to provide bell reinforcement with adequate concrete cover. Extend longitudinal reinforcement to within one inch from both terminal ends of pipe. Provide horizontal (circumferential) reinforcement at end reinforcement at maximum 1-1/4 inches on center.

Pipe for sanitary sewers shall have bell and spigot ends with rubber gaskets joints meeting requirements of ASTM C361. Lifting holes will not be permitted.

Pipe for storm drains shall have ends suitable for standard mortar or mastic joints. Lifting holes will be permitted.

Non-float concrete pipe shall meet the requirements specified above and the following:

Outside diameter shall be increased so that the pipe contains sufficient concrete to resist flotation with the pipe empty and uncovered. Increased thickness shall be homogeneous or heterogeneous of same concrete f'c as contiguous pipe and reinforced as required to prevent shrinkage and temperature cracks.

Joints shall be interchangeable with those of the contiguous sewer pipe.

Reinforced concrete elliptical pipe and fittings for storm drains shall meet requirements of the ASTM C507 as modified herein.

Pipe shall be substantially free of surface roughness. The interior walls shall be substantially a smooth surface and be free from noticeable and harmful ridges, corrugations, elevations and depressions. The finished surface shall be free of any material which is not an integral part of the compacted concrete such as loose aggregate, cementitious slurry coats, silt, cement and non-required markings.

Pipe shall be tested to the 0.01-inch crack load and then to the specified ultimate strength.

Pipe shall have ends suitable for standard mortar or mastic joints. Lifting holes will be permitted.

Reinforced concrete pipe designated on the plans by D loads shall meet requirements of ASTM C655 as modified herein.

Pipe shall be tested to the 0.01 inch crack load and the to the ultimate load specified.

Perform absorption tests as specified in ASTM C76.

In addition to causes for rejection set forth in ASTM C655, pipe shall be subject to rejection for the following causes:

Surface defects indicated honeycombing.

Joints for sanitary sewers shall meet requirements specified elsewhere herein. Pipe for storm sewers shall have ends suitable for standard mortar or mastic joints.

At PVC house connection to main of another material, provide approved coupling or adapter as required for watertight seal as directed by the Engineer.

Provide watertight plug on PVC house connection at property line.

Pipe stronger than that designated may be furnished provided such pipe meets or exceeds in all other respects the requirements specified herein.

Ductile iron pipe for force mains shall meet requirements set forth in Section 02660 of these specifications.

Cast in place concrete shall be as specified in Section 03300 of these specifications, class as indicated in the Standard Details and the Plans.

Manhole Adapters:

PVC manhole adapters shall be Vassallo, or approved equal, as shown on Details SS-23a and SD-14a.

Stoppers:

Stoppers for concrete sewers from six to twelve inches shall be concrete with a spigot end for a rubber gasket for installation in the bell end of the stub or terminating line.

Stoppers for concrete sewers 15 inches and larger shall be concrete as described elsewhere herein or metal. Provide brick bulkheads when directed by the Engineer.

Stoppers for all other types of pipe shall be watertight and of an approved design as furnished by the pipe manufacturer.

Granular bedding material is specified in Section 02200 of these specifications.

Precast concrete manholes are specified in Section 03480 of these specifications.

Castings shall meet the following requirements:

Manhole steps shall be of the size and spacing shown on the Standard Detail and shall conform to the requirements of ASTM C478 as supplemented herein:

Exposed materials shall be resistant to corrosion and deterioration.

Cast iron steps shall meet requirements of ASTM A-48, Class 30-A.

Threads shall have a non-slip surface.

Manhole and lamp hold frames, covers, inlet frames and grates shall be grey iron as specified in Section 05500 of these specifications. All manholes located in 100-year floodplains or in stormwater spread areas in roadways shall be watertight.

Miscellaneous metal connectors and appurtenances shall be in accordance with requirements set forth in elsewhere in these specifications and the Standard Details and Plans.

Jointing mastic shall be an elastic, water resistant formulation of plastic bituminous materials and invert fillers so combined that when applied to a vertical metal surface and heated to 120° F, the jointing mastic will neither slump nor lose plasticity. When applied directly from the container without further fixing the jointing mastic can be applied in an even, adherent coat within the temperature range of 20° to 100° F.

Mortar for pipe joints shall consist of one part Portland cement and two and one-half parts of volume of mortar sand conforming to ASTM C144. Mortar shall be used within one hour after addition of the water.

Masonry work shall be as specified in Section 04200 of these specifications.

Filter cloth for under drain system shall be woven or nonwoven polypropylene cloth, rot proof and resistant to chemical conditions.

Drainage stone for under drain system shall be well graded coarse aggregate MSHA SRC gradation 6.

Asphalt based waterproof coating for exterior of manholes shall be mineral filled solvent type meeting requirements of MIL-C-82052.

Quick setting non-shrink grout shall conform to requirements of Corps of Engineers CRD-588, octocrete, speedcrete or equal.

Flexible plastic gasket between manhole and manhole frame shall be extruded rope type B, in accordance with AASHTO M-198, butyle based, 3/4 inch diameter minimum.

Expansion joint filler shall be Type 1 in accordance with ASTM D-1752.

3. Execution

A. Preparation

Trench excavation and backfill shall be as specified in Section 02200 of these specifications. Before commencing excavation at each location, dig test pits as directed by the Engineer to determine the adequacy of the grade from the mainline sewer to the property line, thence to the house to be served. Should the grade be inadequate, notify the Engineer and do not proceed with that connection until resolution of the problem. Excavate tests pits as specified elsewhere in these specifications, sufficiently in advance of trench construction so that reasonable changes in line and grade can be made where the location of existing structures varies from that shown. Completely excavate sufficient trench to assure that no unforeseen obstructions exist before commencing pipe installation. Work occasioned by failure to take such precautions shall be performed at no cost to the City.

Provide Granular bedding material under all storm drain and sanitary sewer pipe in accordance with the Standard Details and as specified in Section 02200 of these specifications. Provide encasement and/or concrete cradle where indicated on the Plans. Insure that pipes are well bedded.

B. Laying Pipe

Lay pipe to a true uniform line and grade as indicated with continuous bearing of barrel on cradle or bedding material. Handle pipe and fittings with care so as to avoid damage. Where indicated, provide erosion checks or concrete anchors in accordance with the Standard Details.

Lay pipe up-grade with the bell or groove pointing in the direction of upstream. Lay each section of pipe 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 spigot end of each pipe shall be fully inserted into the bell until it is fully home.

Construct mitered and curved bends where indicated in accordance with the Standard Details and the Plans. Curved bends shall have a uniform interior radius.

Construct curves for sanitary sewers by use of beveled pipe, short lengths and by opening of joints in accordance with the following table:

| <u>Pipe Size</u> | <u>Maximum Joint Opening</u> |
|------------------|------------------------------|
| thru 36" | 1/2" |
| 42" thru 60" | 3/4" |
| 66" thru 102" | 1" |
| 108" thru 144" | 1-1/4" |

Construct curves for storm sewers by use of beveled pipe, short lengths, and joint openings not to exceed 1/3 the pipe joint depth.

For any pipe size less than or equal to 24", beveled pipe shall be used.

Place sufficient backfill on each section of pipe, as it is laid to hold firmly in place.

Place circular reinforced concrete pipe with elliptical reinforcement so that the mark which delineates the minor axis of the reinforcing is centered on the top of the pipe, and is easily visible from the top of the trench.

Clean out the interior of the pipe as the work progresses. Utilize a suitable swab or drag in small diameter pipe and pull forward past each joint immediately after the jointing has been complete.

Keep trenches and excavations free of water during construction and until final inspection. When the work is not in progress, securely close open ends of pipe and fittings to prevent trench water, earth or other substances from entering the pipes or fittings.

Provided a minimum of 42" of cover over polyvinyl chloride, ABS and concrete pipe.

C. Sewer House Connection

Provide sewer house connections and sewer drop house connections where indicated in accordance with the Standard Details.

Where possible, place house connections simultaneously with construction of new main line sewer before backfilling main line sewer.

Lay house connection pipe at a 2 % grade, unless otherwise indicated on plan. Excavate 5 to 10 feet beyond end of mains and sewer house connections on minimum percent grade to ensure that no rock is encountered.

Terminate house connection pipe at property line with bell end an approved plastic plug and a cleanout.

D. Joints

Mastic Joints for Concrete Storm Drain:

Bell and spigot joints – **clean the interior surface of the bell thoroughly then fill the lower portion of the bell with sufficient thickness of mastic to make the inner surfaces of the abutting sections flush. Fit the spigot end of the adjoining pipe into the bell so that the sections are closely fitted and aligned. Apply sufficient jointing mastic to fill the remaining void in the joint. Clean off excess mastic from the interior of the pipe. Utilize a suitable swab or drag in small diameter pipe and pull forward part of each joint immediately after the jointing has been completed.**

Tongue and groove joints – **clean the groove thoroughly then apply mastic to the lower half of the groove. Clean the tongue of next pipe and apply a layer of mastic to the upper half. Fit the tongue into the groove until the pipes are**

closely fitted and aligned and the mastic is squeezed out onto the inner and outer surfaces. Clean off excess mastic from the interior of pipe.

Mortared Joints for Concrete Storm Drain:

Bell and spigot joints – where pipe cradle is aggregate place a shallow bed of mortar under the joint. Thoroughly wet the bell and fill the lower half with mortar. Thoroughly wet the spigot and uniformly fit into the bell so that the sections are closely fitted and aligned. Fill the remaining annular space in the bell with mortar sufficient to form a bead around the outside of the spigot end of the pipe. Remove excess mortar from the interior of pipe and finish exterior and interior to smooth surfaces.

Tongue and groove joints – thoroughly wet the groove then apply mortar to the lower half of the groove. Thoroughly wet the tongue of the next pipe and apply a layer of mortar to the top half. Fit the tongue into the groove until the pipe are closely fitted and aligned and the mortar is squeezed onto the inner and outer surfaces of the joint. Clean off the inner surface of the pipes at the joint and point up the outside with a bead of mortar.

Joints for Concrete Sanitary Sewer:

Prior to joining pipe, liberally coat pipe joints with lubricant. Fit the bell or spigot with gasket according to manufacturer's instructions. Join the pipes with equipment designed for the purpose. Before the joint is completely home, check the position of the gasket using a suitable gauge. If the gasket is found to be dislocated, repeat the entire joining process using a new gasket. The rubber gasket shall be the sole element relied upon for water tightness.

For pipe with steel end ring joints, after the joining has been complete, completely fill the exterior joint spaces with mastic or mortar. Fill interior joint spaces of such pipes 30 inches and larger in diameter with mastic or mortar and remove excess material from the inside of the pipe.

Joints for Vitrified Clay Pipe:

Joints for polyvinyl chloride pipe shall be elastomeric gasket joint assembled with the manufacturer's recommendations. When installing pipe, push spigot end home in bell of receiving pipe.

Immediately before joining vitrified pipe, liberally coat the bell with lubricant for pipe joints and fit the spigot with a gasket.

Join pipes using equipment designed for the purpose.

Joints for cast iron pipe for main line sewers shall be as specified in Section 02660.

Joints for cast iron soil pipe for house connections shall be lead as specified in Section 02660, or neoprene compression gaskets as specified hereinbefore.

E. Connections with Existing Systems

Sanitary Systems:

Connect sewer house connections to main lines according to Standard Details.

Installation of saddles of tapping of existing mains shall be performed by City personnel only.

Storm Drain:

Provide field connections in accordance with the Standard Details and the Plans. Provide a smooth finish on the interior of the connections.

Abandoned storm drain systems, when encountered during the work, shall be bricked shut or otherwise closed in a manner acceptable to the Engineer.

Sewer Manholes:

Tightly mortar in pipe to manholes 48" and larger with quick setting non-shrink grout.

F. Brick Construction

Perform brick construction as specified in Section 04200 for Utility Structures, in accordance with Standard Details and the Plans.

G. Manholes.

Manholes shall be watertight. Coat exterior of brick manholes with one-half (1/2) inch coating to the limits indicated on the Standard Details.

Construct manholes of precast sections, cast in place concrete, or brick in accordance with Standard Details and the Plans. Place axis of manholes directly over the centerlines of the pipes unless otherwise shown.

Construct appropriate flow channels in the bottom of manholes, as shown on the Standard Details and the plans and specified herein below:

Sewer manhole – line channels in bottom with brick up to the crown of the pipes.

Storm drain manhole – line channels with brick up to the crown of the pipes.

Cut the pipe three inches from the inside face of the structures. When installing ABS or PVC pipe one of the adapters, as described herein above for connection to manholes, shall be provided and installed per the Standard Detail or in accordance to manufacturers procedure using quick setting non-shrink grout. All other pipe shall be directly mortared into the manhole opening with non-shrink grout.

In storm manholes, provide a mortar joint between the pipe and structure. Provide blank connections or stubs not less than 16 inches in length where indicated and provide a watertight stopper which shall be easily removable.

In manholes 48 inch or larger, tightly mortar in pipe with quick setting non-shrink grout.

Manhole Frames and Covers: All manhole frames and covers (sanitary and storm drain) shall be bolted to the top section of the structure using 5/8 inch all thread dowels and non-shrinking grout unless otherwise directed.

H. Storm Drain Inlets

Construct inlets of cast in place concrete or precast sections, concrete block or brick in accordance with the Standard Details and the Plans after grading has been substantially completed as determined by the engineer.

Inlet inverts may be of brick, cast-in-place concrete or air entrained Type II sloped towards outlet pipe on terminal inlets. Provide brick bottom channel in through inlets.

Cut the pipe flush with the inside wall of the structure. Provide a mortar joint between the pipe and structure. Provide blank connections or stubs with a minimum length of sixteen (16) inches, free of leakage, where indicated, and provide a watertight stopper, which shall be easily removable.

Install manhole steps, frame and grate or cover to proper grade.

I. Underdrain Systems

Construct under drain systems where indicated on the plans or where directed by the Engineer. Excavate trench to dimensions indicated and lay filter cloth so as to result in a one foot overlap on the top of the under drain system. Place gravel to the pipe invert where pipe is required. Lay pipe with joints not less than one fourth (1/4) inch and not more than one half (1/2) inch in width. Protect upper end of pipe against the entrance of foreign matter and close with a permeable membrane after completion of pipe laying. Place remaining gravel to the elevation indicated on the plans or designated by the Engineer. Lay filter cloth across top of gravel and complete backfilling operations.

J. Sewer House Connection Renewals

Utilize existing tap at main line unless otherwise directed by the Engineer. Otherwise, abandon existing tap and retap utilizing proper sized saddle or thimble or cut in a tee or wye branch; or remove the existing tamp and cut in an additional tee, as determined by the Engineer, resulting in a watertight joint without jointing collars.

Plug abandoned existing house connections and taps which have been replaced by utilizing approved watertight plugs.

Retap the main line as follows:

Tapping shall be performed by the Contractor.

Where indicated or directed by the Engineer, tap directly into manholes for sewer house connections. Cut through manhole wall and make connection as per Detail SS-23a. Seal sleeve in opening with quick setting concrete so as to make a watertight connection.

Provide cleanouts installed at the property line for all sewer connection renewals in accordance with the Standard Details.

K. Abandonment

Storm sewers under thirty six (36) inches in diameter:

Construct bulkheads of minimum nine (9) inches brick masonry or 2500 psi concrete at structures and at cut ends

Sanitary sewers under thirty six (36) inches in diameter:

Unearth main at manhole and disconnect pipe.

Brick shut pipe opening at manhole and bulkhead disconnected pipe with minimum nine (9) inches bulk masonry or 2500 psi concrete.

Sanitary sewers thirty six (36) inches and over in diameter, use one of the following:

Remove the sewer completely. Brick shut pipe opening at manholes with a minimum of eight (8) inches brick masonry. Waterproof masonry plug and immediate area outside manhole with cement mortar plastered one half (1/2) inch thick followed by two (2) coats of asphalt based coating.

Unearth sewer main at the manholes and remove the pipe for a minimum of ten (10) feet from the face of the manholes. Brick shut pipe opening at manholes with a minimum of eight (8) inches brick masonry. Waterproof masonry plug and immediate area outside manhole with cement mortar plastered one half (1/2) inch thick followed by two (2) coats of asphalt based coating. Bulkhead disconnected pipe with minimum twelve (12) inches bulk masonry or 2500 psi concrete.

Brick shut pipe opening at manholes with a minimum of eight (8) inches brick masonry. Waterproof masonry plug and immediate area outside manhole with cement mortar plastered one half (1/2) inch thick followed by two (2) coats of asphalt based coating. Pump the sewer full of non-shrink type grout or lean mixture of sand and cement.

Storm and sanitary manholes and structures:

Remove frame and cover and return to the City.

Remove structure to a minimum of two (2) feet below finished grade.

Break up base slab or bottom to provide drainage and backfill as specified in Section 02200. Abandon adjacent storm and sanitary sewers as necessary.

4. Measurement and Payment

A. Sewer Pipe

Furnishing and installing sewer pipe will be measured for payment by the linear foot of the various types and sizes provided, measured horizontally along the centerline of the pipe from center of structures. No deductions will be made for the lengths of fittings or connections.

Payment will be made for the quantities measured at the unit price per linear foot for the various sizes listed in the bid schedule. Pipe noted in the bid schedule as contractor's option shall be of materials specified hereinbefore.

Payment will include provision of fittings, connections to new and existing facilities and T and Y branches, and various sized drop connections at manholes.

Payment will include excavation, backfill and bedding as specified in Section 02200.

B. Storm Drain Pipe

Furnishing and installing storm drain pipe will be measured for payment by the linear foot of the various types and sizes provided, measured horizontally along the centerline of the pipe from center to center of manholes or structures. No deductions will be made for the lengths of fittings or connections.

Payment will be made for the quantities measured at the unit price per linear foot for the various sizes listed in the bid schedule.

Payment will include provision of fittings and connections to new and existing facilities.

Payment will include excavation, backfill and bedding as specified in Section 02200.

C. House Connections

Furnishing and installing house connections will be measured by the linear foot of the various types and sizes provided, measured horizontally along the centerline of the pipe from center of main line sewer for house connections placed simultaneously with sewer and for house connections placed after backfill of sewer. No deductions will be made for the lengths of fittings or connections.

Payment will be made for the quantities measured at the unit price listed for the various sizes and types in the bid schedule.

Payment includes provision of fittings, thimbles, drop house connections and connections to new and existing facilities, pipes and manholes and installation of saddles.

Payment includes excavation, backfill and bedding as specified in Section 02200.

D. Manholes

Furnishing and installing manholes will be measured for payment by the vertical foot measured from the invert to the bottom of the frame of the various types and sizes complete in place, including installation of the frames and covers.

Payment will be made for the quantities measured at the unit price per vertical foot for the various types and sizes listed in the bid schedule.

Payment will include excavation, backfill and bedding as specified in Section 02200 and provision of drop connections of the proper size and type required and concrete, where indicated.

E. Lampholes

Furnishing and installing lampholes will be measured for payment by each complete in place, including installation of frames and covers.

Payment will be made for the quantities measured at the unit price per each listed in the bid schedule.

Payment will include excavation, backfill and bedding as specified in Section 02200.

Payment will include the appropriate size Y branch.

F. Inlets, End Walls, Cut Off Walls and Entrance Structures

Furnishing and installing inlets, end walls, cut off walls and entrance structures will be measured for payment by each of the various types, complete in place, including installation of frames and covers.

Payment will be made for the quantities measured at the unit price per each of the various structures listed in the bid schedule.

Payment will include excavation and backfill as specified in Section 02200 and connection to new and existing pipes.

G. Underdrain System

Providing under drain system with and without pipe will be measured for payment by the cubic yard of drainage stone actually placed for underdrains with pipe and for underdrains without pipe.

Payment will be made for the quantities measured at the unit price per cubic yard listed for the various types in the bid schedule.

Payment will include excavation and backfill as specified in Section 02200, pipe (where applicable) and filter cloth.

H. Furnishing Pipe to be Installed in Tunnels

Furnishing and installing pipe in tunnels for storm or sanitary sewer systems shall be measured by the linear foot measured along the centerline of the tunnel from inside face to inside face of access shafts.

Payment will be made for the quantity measured of the various sizes of pipe at the unit prices listed in the bid schedule.

I. Concrete Encasement and Cradle

Constructing concrete encasement and cradle will be measured for payment by the cubic yard of concrete actually placed.

Payment will be made for the quantities measured at the unit prices per cubic yard listed in the bid schedule.

J. Non-Payment Items

The following items will not be measured for payment but the cost thereof will be considered as incidental to the contract:

Removal of existing facilities as necessary to complete the project.

Abandonment, plugging and disposal of existing facilities.

Restoration and restabilization of disturbed areas.

Stoppers, plugs and stubs.

Testing.

Timber-marking house connections.

Replacement of various appurtenant connections and devices required for watertight construction.

Concrete anchors and erosion checks.

Adjustment of manholes frames and covers, as indicated.

SECTION 02770

STORMWATER MANAGEMENT PRACTICES

1. General

A. Description

This section includes all work necessary for the construction of earth retention structures and pipe spillways classified as Category IV dams by the Maryland State Department of Natural Resources for the control of stormwater discharge. Dams in this category are limited to structures less than fifteen feet in height and with storage volumes less than 100 acre-feet.

Where more stringent construction specifications appear on the approved Plans or in the Special Provisions, such specifications shall take precedence over this specification.

When infiltration practices are indicated on the approval plans, their construction shall be in strict accordance with the Maryland Standards and Specifications for Stormwater Management Infiltration Practices. Construction of such practices are not made a part of this specification.

B. Reference Documents

The Contractor shall obtain and maintain on the site at all times a copy of the 1983 Maryland Standards and Specifications for Soil Erosion and Sediment Control and a copy of the Maryland Standards and Specifications for Stormwater Management Infiltration Practices, as amended, if infiltration practices are included in the contract documents. Copies of the specifications are available from the Soil Conservation District and the Maryland Department of Natural Resources, Water Resources Administration, Stormwater Management Division respectively.

2. Quality Assurance

The Contractor will engage the services of a soils testing agency to inspect and test the fill material; the foundation of the fills, the construction of the embankment and fills, and certify to the City their conformance to all the regulations specified. The testing firm selected must be submitted for approval to the City.

3. Materials

Earth Materials:

The fill material shall be taken from approved designated borrow area or areas. It shall be free of roots, stumps, wood, rubbish, oversize stones, frozen or other objectionable materials.

Steel pipe:

This pipe and its appurtenances shall be galvanized and fully bituminous coated and shall conform to the requirements of AASHTO Specification M-190 Type A with watertight coupling bands. Any bituminous coating damaged or otherwise removed shall be replaced with cold applied bituminous coating compound.

Aluminum Pipe:

This pipe and its appurtenances shall conform to the requirements of AASHTO Specification M-196 or M-211 with watertight coupling bands. Coupling bands, anti-seep collars, end sections, etc. must be composed of the same material as the pipe. Metals must be insulated from dissimilar materials with use of rubber or plastic insulating materials at least 24 mils in thickness. Aluminum surfaces that are to be in contact with concrete shall be painted with one coat of zinc chromate primer. Hot dip galvanized bolts may be used for connections. The pH of the surrounding soils shall be less than 9 and greater than 4.

Helically corrugated pipe in addition to the requirements above shall have either continuously welded seams or have lock seams which are caulked, during fabrication, with a neoprene bead.

Reinforced Concrete Pipe:

Reinforced concrete pipe shall have a rubber gasket joint and shall equal or exceed ASTM Specification C-361. Approved equivalents are AWWA Specification C-300, 301, and 302.

Appurtenances:

Anti-seep collars, valves, trash racks, etc. shall meet the material requirements specified on the approved Plans.

Concrete:

Normal Portland cement shall conform to the latest ASTM Specification C-150.

The water used in concrete shall be clean, free from oil, acid, alkali, scales, organic matter or other objectionable substances.

The sand used in concrete shall be clean, hard, strong and durable, and free from clay or silt. It shall be well graded with 100 percent passing a one-quarter inch sieve.

The concrete shall be mixed in the following proportions, measured by weight. The water-cement ratio shall be 5-1/2 to 6 U.S. Gallons of water per 94 pound bag of cement. The proportion of materials for the trial mix shall be 1:2:3-1/2. The combination of aggregates may be adjusted to produce a plastic and workable mix that will not produce harshness in placing or honeycombing in the structure.

The concrete ingredients shall be mixed in batch mixers until the mixture is homogeneous and of uniform consistency. The mixing of each batch shall continue for not less than one and one-half minutes after all the ingredients, except the full amount of water, are in the mixer. Water shall be added prior to, during, and following the mixer-charging operations. Excessive over mixing requiring the addition of water to preserve the required concrete consistency shall not be permitted. Truck mixing will be allowed provided that the use of this method shall cause no violation of any applicable provisions of the specifications given here.

Reinforcing Steel:

The reinforcing steel shall be deformed bars of intermediate grade billet steel or rail steel conforming to ASTM Specification A-615.

4. Execution

A. Site Preparation

Areas under the borrow areas, embankment, and structural works shall be cleared, grubbed and the topsoil stripped to remove all trees, vegetation, roots or other objectionable material. Channel banks and sharp breaks shall be sloped to no steeper than 1:1.

Areas covered by the pond or reservoir will be cleared of all trees, brush, logs, fences, rubbish and other objectionable material unless otherwise designated on the plans. Trees, brush and stumps shall be cut approximately level with the ground surface.

All cleared and grubbed material shall be disposed of outside the limits of the dam and reservoir as directed by the Engineer. When specified, a sufficient quantity of topsoil will be stockpiled in a suitable location for use on the embankment and other designated areas.

B. Embankments and Fills

Areas on which fill is to be placed shall be scarified prior to placement of fill. Fill materials shall be placed in 8-inch maximum thickness (before compaction) layers which are to be continuous over the entire length of the fill. The most porous borrow material shall be placed in the downstream portions of the embankment.

The embankment shall be constructed to an elevation, which provides for anticipated settlement to the design elevation. The fill height all along the

length of the embankment shall be increased above the design elevation (including freeboard) as shown on the plans.

The movement of the hauling and spreading equipment over the fill shall be controlled so that the entire surface of each lift shall be traversed by not less than one tread track of the equipment or compaction shall be achieved by a minimum of four complete passes of a sheepsfoot, rubber tired or vibratory roller. Fill material shall contain sufficient moisture such that the required degree of compaction can be obtained with the equipment used.

Where specified, a cutoff trench shall be excavated along or parallel to the centerline of the embankment as shown on the plans. The bottom width of the trench shall be governed by the equipment used for excavation, with the minimum width being four feet. The depth shall be at least four feet or as shown on the plans. The side slopes of the trench shall be 1:1 or flatter. The backfill material for the cutoff trench shall be the most impervious material available and shall be compacted with equipment or rollers to assure maximum density and minimum permeability.

Structural backfill material shall be of the type and quality conforming to that specified for the adjoining fill material. The fill shall be placed in horizontal layers not to exceed four inches in thickness and compacted by hand tampers or other compaction equipment. The materials needs to fill completely all spaces under and adjacent to the pipe. At no time during the backfilling operation shall driven equipment be allowed to operate closer than four feet measured horizontally, to any part of a structure. Under no circumstance shall the Contractor drive equipment over any part of a concrete structure or pipe unless there is a compacted fill of twenty-four inches or greater over the structure or pipe.

C. Laying Metal Pipe

The pipe shall be placed with inside circumferential laps pointing downstream and with the longitudinal laps at the sides.

The pipe shall be firmly and uniformly bedded throughout its entire length. Where rock or soft, spongy or other unstable soil is encountered, all such material shall be removed and replaced with suitable earth compacted to provide adequate support.

Backfilling shall conform to structural backfill as shown above.

Other details (anti-seep collars, valves, etc.) shall be shown on the drawings.

All connections with pipes must be completely watertight. The drain pipe or barrel connection to the riser shall be welded all around when the pipe and riser are metal. Watertight coupling bends shall be used at all joints. Antiseep collars shall be connected to the pipe in such a manner as to be completely watertight.

D. Laying Concrete Pipe

Bell and spigot pipe shall be placed with the bell end upstream. Rubber gasket joints shall be made in accordance with the recommendations of the manufacturer of the material. After the joints are sealed for the entire length of conduit, the bedding shall be placed so that all spaces under the pipe are filled. Care shall be taken to prevent any deviation from the original line and grade of the pipe.

All reinforced concrete pipe conduits shall be laid in a concrete bedding for their entire length. This bedding shall consist of high slump concrete placed under the pipe and up the sides of the pipe at least 10% of its diameter with a minimum thickness of three inches.

Backfill shall conform to structural backfill as specified above.

Other details (anti-seep collars, valves, etc.) shall be as shown on the plans.

E. Placing Concrete

The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping, and vibration without deflection from the prescribed lines. They shall be mortar-tight and constructed so that they can be removed without hammering or prying against the concrete.

The inside of forms shall be oiled with a non-staining mineral oil or thoroughly wetted before concrete is placed.

Forms may be removed 24 hours after the placement of concrete. All wire ties and other devices used shall be recessed from the surface of the concrete.

All reinforcing material shall be free of dirt, rust, scale, oil, paint or any other coatings. The steel shall be accurately placed and securely tied and blocked into position so that no movement of the steel will occur during placement of concrete.

Concrete shall be consolidated with internal type mechanical vibrators. Vibration shall be supplemented by spading and hand tamping as necessary to insure smooth and dense concrete along form surfaces, in corners, and around embedded items.

Defective concrete, honeycombed areas, voids left by the removal of tie rods, ridges on all concrete surfaces permanently exposed to view or exposed to water on the finished structure, shall be repaired immediately after the removal of forms. All voids shall be reamed and completely filled with drypatching mortar.

Exposed surfaces of concrete shall be protected from the direct rays of the sun for at least the first three (3) days. All concrete shall be kept continuously moist for at least ten (10) days after being placed. Moisture may be applied by spraying or sprinkling as necessary to prevent the concrete from drying. Concrete shall not be exposed to freezing during the curing period. Curing compounds may also be used as directed by the engineer.

Concrete may not be placed at temperatures below 37°F with the temperature falling, or 34° with the temperature rising.

F. Stabilization

All borrow areas shall be graded to provide proper drainage and left in a slightly condition. All exposed surfaces of the embankment, spillway, spoil and borrow areas, and berms shall be stabilized in accordance with the vegetative treatment specifications shown on the drawings.

5. Certification and As-Built Drawings

Within 30 days after completion of the dam, “as-built” plans shall be submitted to the City. The “as-built” plans shall include the certification by a Registered Professional Engineer that the facility was constructed as shown on the as-built plans and meets the approved plans and specifications.

6. Measurement and Payment

Stormwater management structures will be paid for lump sum for each structure at the contract bid price.

SECTION 02830

CHAIN LINK FENCE

1. General

A. Description

This Section includes providing chain link fencing, gates, accessories and fan guards, as indicated in accordance with the Contract Documents.

B. Submittals

Submit samples labeled with the City contract number, the project name and location, the submittal number, product identification, vendors name, address, and telephone number.

1. Wire mesh fabric: **each width & type to be used – one sample, 12 inches long.**
2. Posts, railing, braces, gate frames: **one sample of each size and type to be used – 24 inches long.**
3. Truss rod and turnbuckles – **one each.**
4. Tension wire – **one sample, 24 inches long.**
5. Barbed wire – **one sample, 24 inches long.**
6. Tension Bar – **one sample, 24 inches long.**
7. Fabric ties with hardware – **four each.**
8. Rail and brace ends and post caps – **two each.**
9. Barbed wire extension arms – **one each type.**

Submit certified test reports labeled as above before delivery of any and all materials furnished under this Section.

2. Materials

A. General

Chain link fencing shall conform to applicable parts of FS RR-F-191 as modified herein.

B. Posts FS-RR-F-191/3A, as modified herein:

Posts, pipes, gate frames, caps, barbed wire and other accessories and fasteners shall be fabricated of hot dip galvanized steel or aluminum alloy FS 6063-T6, as applicable. Posts and rails shall be of the same type material. Weight of zinc coating shall be 1.6 ounces per square foot or greater.

End, corner and pull posts shall conform to the following requirements:

1. Fences five feet and less in height; **Type I, Class 1, 2.374 inch diameter, weighing 3.65 pounds per foot or Type I, Class 3, 2.374 inch diameter, weighing 1.264 pounds per foot.**
2. Fences over five feet in height; **Type I, Class 1, 2.875 inch diameter, weighing 5.79 pounds per foot or Type I, Class 3, 2.875 inch diameter weighing 2.00 pounds per foot.**

Line posts shall conform to the following requirements:

1. Fabric five feet and less in height; **Type I, Class 4, 1.875 inch x 1.675 inch H-Beam weighing 2.70 pounds per foot or Type I, Class 6, 1.875 inch x 1.675 inches, H-Beam weighing 0.91 pounds per foot, or Type I, Class 1, 1.90 inch diameter weighing 2.72 pounds per foot, or Type I, Class 3, 1.90 inch diameter, weighing 0.94 pounds per foot or 1.875 inch C section yield strength 50,000 psi, weighing 2.34 pounds per foot.**
2. Fabric over five feet in height; **Type I, Class 4, 2.625 inch diameter, H-Beam weighing 4.1 pounds per foot or Type I, Class 6, 2.625 inch H-Beam weighing 1.25 pounds per foot, or Type I, Class 1, 2.375 inch diameter, weighing 3.65 pounds per foot, or Type I, Class 3, 2.375 inch diameter, weighing 1.24 pounds per foot or C section as specified herein above.**

Gate Posts shall be in accordance with Table III, FS-RR-F-191/3A.

Gate Frames FS-RR-F-191/2A as modified herein, shall be Type I and Type III, 1.90-inch diameter, weighing 2.72 pounds per foot or 2.00 inch square, weighing 2.60 pounds per foot.

Top rail and braces, FS-RR-F-191/3A as modified herein, shall be Type II, Class 1, 1.66 inch diameter, weighing 1.34 pounds per foot or Type II, Class 3, 1.66 inch diameter, weighing 0.786 pounds per foot. Fences with barbed wire above fabric may have a top tension wire in lieu of top rail.

Barbed wire shall conform to requirements of FS-RR-F221/1A.

Accessories shall conform to FS-RR-R191/4A as modified herein.

Tension wire shall be No.9 gauge coil spring wire.

C. Chain Link Fabric FS-RR-F-191/1A as modified herein:

Fabric shall be one of the following types as shown, fabricated in a two inch mesh of 0.148 inch diameter wire:

1. Type I, zinc-coated steel, minimum 1.8 ounces per square foot coating.
2. Type II, aluminum coated steel, minimum 0.40 ounces per square foot coating.
3. Type V, thermally bonded vinyl coated steel, Table III, 1200 pound minimum breaking load. Precoat fabric with zinc coating minimum 0.30 ounces per square foot. Color shall be as indicated on the Drawings or in the Special Provisions.

Fabric shall be barbed at top and bottom.

D. Fan Guards

Fan guards shall be of the same type materials as the fence of which they are a part.

E. Padlocks

Padlocks shall conform to requirements of FS-FF-P-1016, keyed and master keyed, with two keys for each padlock and two master keys.

F. Concrete

Concrete shall be 2500 psi in accordance with Section 03300 of these specifications.

G. Grout

Grout shall be non-shrink as approved by the Engineer.

3. Execution

A. Fence Installation

Perform the necessary clearing, excavation and filling to provide clear "line of fence" runs.

Encase the posts in concrete to the depth indicated and to the minimum limits contained herein. Extend concrete at least six inches below the bottom of posts. Provide encasement ten inches in diameter for line posts and 12 inches in diameter for end, corner, pull and gate posts.

Fences five feet high and less: **2.5 foot encasement.**

Fences over five feet high: **3.0 foot encasement.**

Gate posts, six foot swing and less: **3.0 foot encasement, 12 inches in diameter.**

Gate posts over six-foot swing: **3.0 foot encasement, 16 inches in diameter.**

Extend concrete to two inches above ground line at posts and slope to drain away from the posts.

Space posts at not more than ten feet nor less than eight feet on centers. Place additional posts at each abrupt change in grade.

Where rock is encountered, drill holes two inches deeper than the depth shown or specified. Drill the holes two inches greater than the outside diameter of the post or the greatest dimension of the H section. Then fill the rock portion of the hole with grout with a ratio of 1:3 of cement and concrete sand.

Where fence is to be located on concrete structures, cast a section of 12 inch long, steel pipe into the concrete at the correct location for the fence posts. Grout the fence posts into the steel pipe with a non-shrink grout as previously specified.

Install corner or pull posts at each horizontal or vertical angle point of 15 degree or more and at no more than 500 foot intervals. Provide corner, end and pull posts with a horizontal brace and tie rod on each side of the posts extending to and connecting to adjacent line posts.

After posts are installed and concrete has set firmly, place top rail and bottom tension wire and securely anchor at ends and to line posts before hanging fabric.

Place tension wire approximately six inches above grade.

Provide brace for gate posts, and at each corner, pull and end post for fabric heights of six feet or greater.

Secure ends of fabric by the use of tension bars threaded through loops in the fabric, and secured to the posts by means of bands with bolts and nuts. Use bands as specified in FS-RR-F-191/4A.

Place fabric by securing one end and applying sufficient tension by means of mechanical fence stretchers to remove slack before making attachments. Fasten the fabric to posts, tension wire and top railing with tie wires at 24 inches on center maximum; attach fabric to posts at 15 inches on center maximum.

Hold the bottom of the fabric uniformly as possible to two inches above finished grade.

Where indicated, provide three strands of barbed wire above fence fabric. Stretch the strands to remove sag and anchor firmly to extension arms. Incline extension arms on line posts away from the City property at approximately a 45 degree angle. Extension arms on corner posts and gates shall be vertical.

Install fence gates, gate stops and fan guards as shown.

Locate gate stops set in concrete accurately so that the plunger can be fully engaged.

Furnish padlocks and chains where indicated.

The following alternate method of post anchorage will be acceptable:

1. Drive post into ground and hold rigidly in position by means of two steel angle anchors driven diagonally and attached to the post on opposite sides.
2. Anchors, attachments and methods shall be in accordance with MSHA Standard Details

B. Defective Work

Remove and replace fencing which is improperly located and is not true to line and grade and posts which are not plumb.

Repair damaged galvanizing of components by thoroughly wire brushing the damaged area to remove loose and cracked zinc coating, and painting with two coats of zinc-dust, zinc oxide primer, MIL-P-21035. Allow the first coat to dry thoroughly before applying the second coat.

Repair damaged aluminum coated components by cleaning as specified above, and painting with two coats of aluminum paint, FS-TT-P-38.

4. Measurement and Payment

A. Fencing

Fencing shall be measured by the linear foot for each type and height actually placed.

Payment shall be made for the quantities measured at the price per linear foot listed in the Bid Schedule.

Payment will include posts and post foundations, all materials required and all incidentals necessary to provide the finished product.

B. Gates

Gates will be measured by each type, size and height, in place.

Payment will be made for the quantities measured at the price per each listed in the Bid Schedule.

Payment will include gate posts.

SECTION 02930

SEEDING AND SODDING

1. General

A. Description

This Section includes seeding and sodding to the limits shown as required for restoration and restabilization of disturbed areas, and as directed by the Engineer, including preparation of seed and sod bed, fertilizer, lime and mulch, in accordance with the Contract Documents.

B. Submittals

Submit certificates of compliance before delivery of materials for the following items:

1. **Topsoil**
2. **Seed**
3. **Sod**
4. **Fertilizer**
5. **Lime**
6. **Mulch**

C. Construction Criteria

The following classes of restoration as defined below are noted in the Restoration Schedule on the drawings.

Type A Sod (**established lawns, park lawns and highly mowed public spaces**). **Commence continuous restoration work within 10 days after completion of work between first manholes but no later than 10 days after commencement of trench excavation operations.**

Type B Sod (**sodded swales**)

Type C Surge Stone (**seeded and stone – lined swales**)

Type D Seed (**Improved areas**) Type of seeding operation shall be as specified in II.B. of this section.

Type E Seed (unimproved and outfall areas). Type of seeding operation shall be specified in II.B. of this section.

Type F (Development sites with existing stabilization of temporary mulch or planted seed). Restore in kind and maintain.

D. Reference Documents

The Contractor shall obtain and maintain on the site at all times a copy of requirements of Maryland Turf Grass Law and Regulations, Publication No. 41, available from the Seed and Turf Lab, Agronomy Department, University of Maryland, College Park, Maryland 20742.

2. Materials

A. Topsoil

General Requirements:

1. Topsoil shall consist of fertile, agricultural soil capable of sustaining vigorous plant growth. It shall contain not less than 1-1/2 percent organic matter as determined by MSHA Standard Method of Testing and shall have a pH value between 6.0 and 7.6.
2. Topsoil shall be free of roots, rubbish and other objectionable materials such as Bermuda grass, poison ivy and kindred roots and any material harmful to plant growth. Topsoil shall provide sufficient pore space to permit adequate root penetration.
3. Topsoil shall meet the following analysis as determined by the MSHA Standard Hydrometer Test. Sand, silt, and clay are defined in AASHTO M146.

| <u>Minimum Percent</u> | | <u>Maximum Percent</u> | |
|------------------------|-----|------------------------|-----|
| Sand | 30% | | 50% |
| Silt | 30% | | 50% |
| Clay | 5% | | 20% |

4. Special purpose topsoil shall be used where indicated. General purpose topsoil shall be used in all other areas.

Special Purpose Topsoil

1. Special purpose topsoil shall meet the requirements listed above with the following gradation:

| <u>Sieve</u> | <u>Minimum Percent Passing</u> |
|--------------|--------------------------------|
| 2" | 100% |
| No. 4 | 90% |
| No. 10 | 80% |

2. **Special purpose topsoil shall be capable of hand spreading.**
3. **General Purpose Topsoil**
General purpose topsoil shall meet the General Requirements set forth above and shall contain no stones greater than 1-1/4 inches in their greatest dimension.
4. **Materials available on site which meet the specified requirements may be utilized with the permission of the Engineer.**

B. Seed

Unless otherwise specified herein, seed shall be certified by the Maryland State Board of Agriculture and shall conform to requirements of Maryland Turf Grass Law and Regulations, Publication Number 41.

Supply the following for improved areas which will be mowed regularly, and are dry and semi shady.

Semi-Shade Mix

Kentucky Bluegrasses
20 – 30% Certified Merion
20 – 30% Certified Kenblue or South Dakota Certified
10 – 40% Certified Adelphi, Baron, Birka or Pennstar

Creeping Red Fescue
10 – 50% Certified Pennlawn or Jamestown

Seeding Rate: Sow mixture at 260 pounds per acre, or six pounds per 1,000 square feet between March 1 and May 31 and between August 15 and October 31.

Premixed certified seed mixture labeled “Maryland Certified 30-30-30-10 Seed Mixture” will be acceptable.

Supply the following for improved areas which will be mowed regularly and are dry, in heavy shade:

Heavy Shade Mix

Kentucky Bluegrass
20% Certified Merion
30% Certified Kenblue or South Dakota, Adelph, Baron, Birka or Pennstar (any combination thereof)

Creeping Red Fescue
50% Certified Pennlawn or Jamestown

Seeding Rate: **Sow mixture at 140 pounds per acre or three pounds per 1,000 square feet between March 1 and May 31 and between August 15 and October 31.**

Supply the following for unimproved areas not to be mowed (or mowed infrequently) and are drought-prone:

Drought-Prone Mix

Tall Fescue:

80 – 90% Certified Kentucky 31

Annual Rye Grass:

10 – 20% (Certification not required)

Seeding Rate: **Sow mixture at 130 pounds per acre or three pounds per 1,000 square feet between March 1 and May 31 and between August 15 and October 31.**

Supply the following for unimproved areas which are poorly drained areas and areas that are subject to frequent flooding:

Wet Area Mix

Tall Fescue:

75% Certified Kentucky 31

Reed Canarygrass:

25% (Certification not required)

Seeding Rate: **Sow mixture at 130 pounds per acre or three pounds per 1,000 square feet between March 1 and May 31 and between August 15 and October 31.**

Supply one of the following for temporary grass stabilization:

Temporary Seed Mixture

Sudangrass or Annual Ryegrass: Seeding rate; sow mixture at 40 pounds per acre or one pound per 1,000 square feet between March 15th and May 31st and between August 15th and October 15th.

Millet: Seeding Rate; sow mixture at 40 pounds per acre or one pound per 1,000 square feet between May 31st and August 15th.

Do not use the above in maintained turf areas.

C. Sod

General:

Sod shall be Certified or Approved grade as designated by the Maryland State Board of Agriculture and shall conform to Requirements of Maryland Turf Grass Law and Regulations, publications number 41. Sod shall be machine cut at a uniform thickness of 3/4 inch plus or minus 1/4 inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will not be acceptable.

Sod replacing previously established stand of turf shall be similar in kind to that which existed prior to construction.

Sod placed where no grass existed prior to construction or replacing a lawn consisting mainly of coarse textured grass without a dominant species shall be as follows:

“Maryland State Approved” Multi-Use Turf Sod

Tall Fescue:

90 – 100% Certified Kentucky 31

Kentucky Bluegrasses:

0 – 10% Certified Kenblue (Kentucky origin), Certified Merion, or South Dakota Certified

Sod replacing a lawn consisting mainly of fine textured grass without a dominant species shall be as follows:

Maryland Certified 30-30-30-10 sod.

D. Fertilizer

Fertilizer shall be uniform in composition, free flowing and delivered to the site fully labeled according to applicable state fertilizer laws and shall bear the name, trade name or trademark and warranty of the producer.

The Contractor may submit soils samples to an approved soils testing laboratory for fertilizing recommendations. Recommendations shall be submitted to and approved by the Environmental Matters Section before implementation.

Otherwise, fertilize at the following rates:

1. Temporary Seeding:

Supply 10-20-10 or equivalent at the rate of 600 pounds per acre or 15 pounds per 1,000 square foot.

2. Permanent Seeding:

Supply 600 pounds of 0-20-20 per acre with limestone. Immediately prior to seeding, supply 400 pounds of 38-0-0 ureaform and 500 pounds of 10-20-20 or equivalent per acre.

3. Sodding:

Supply 15 pounds of 10-20-10 per 1,000 square feet. Immediately prior to sod installation, supply 3.5 pounds of slow release nitrogen per 1,000 square feet. Slow release nitrogen shall be approximately 1/3 immediately available and 2/3 water insoluble, such as Urea formaldehyde or isobutyledene urea.

E. Lime

Lime shall be ground limestone containing at least 50 percent total oxides (calcium oxide plus magnesium oxide). Limestone shall be ground to such a fineness that at least 50 percent will pass through a 100 mesh sieve and 98% will pass through a 20 mesh sieve.

Supply 70 pounds per 1,000 square feet (1-1/2 tons per acre) on sandy and silty soils or 100 pounds per 1,000 square feet 2.3 per acre) on clay or clay loam soils.

F. Mulch

Mulch for protection of permanent seeding shall conform to the following requirements:

1. **Straw, clean, weed free, unrotted straw applied at a rate of not less than 70 pounds per 1,000 square feet (1-1/2 tons per acre) and shall be anchored with: Mulch anchoring tool (flat slopes), mulch nettings, cut back and emulsified asphalt (five gallons per 1,000 square feet), Curasol AH (five gallons per 1,000 square feet), Terra Tack II (20 gallons per 1,000 square feet), or Petroset (Manufacturer's recommendations).**

2. **Mulch nettings, jute or excelsior blanket.**

Mulch utilized as temporary protection and stabilization shall conform to the above materials requirements. Rate of application shall be as directed by the Engineer. Stone mulch will be permitted at the option of the Engineer.

3. **Wood chips, coverage to be 1-1/2 inches deep.**

Use either straw or cellulose wood fiber for landscaping.

3. Execution

A. Permanent Seeding:

1. **Harrow, disc, or otherwise loosen subsoil to a depth of four inches. Spread topsoil evenly over prepared subsoil to the following depths:**

Slopes 3:1 or steeper; **two inches after compaction**

Slopes flatter than 3:1; **four inches after compaction**
2. **Remove objectionable material such as stones, 1-1/2 inches or larger, clods, brush, roots and trash from the top four inches of soil.**
3. **Apply lime and fertilizer at the rates specified in "Materials", and thoroughly mix into the top six inches. Scarify the area and rake until the surface is leveled up to provide a maximum of two inches in variation, and the soil is friable and of uniform fine texture.**
4. **Immediately prior to seeding apply additional fertilizer at the rates specified in "Materials", and work into the top two inches of the soil.**
5. **Perform harrowing discing, scarifying and raking on the contour of slopes steeper than 3:1.**
6. **Moisten seedbed during periods of high temperatures and when directed by the Engineer.**
7. **Apply seed mixture uniformly with mechanical power driven seeders, mechanical cyclone hand seeders or hydroseeding equipment. (Slurry for hydroseeder may contain seed and fertilizer only.)**
8. **Disc seed one inch into soil in floodplain areas. Rake, roll or drag the seedbed in all other areas, if hydroseeder or cyclone seeder is used.**
9. **Apply mulch at the rates specified in "Materials".**
10. **Anchor mulch as specified.**

B. Temporary Seeding

1. **Loosen top two inches of seedbed.**
2. **Apply lime and fertilizer at the rates specified in "Materials".**
3. **Moisten seedbed during periods of high temperature and when directed by the Engineer.**

4. **Apply seed mixture uniformly with mechanical power drawn seeders, mechanical cyclone hand seeders or hydroseeding equipment. (Slurry for hydroseeder may contain seed and fertilizer only.)**
5. **Disc seed one inch into soil in floodplain areas. Rake, roll or drag seedbed in all other areas, if hydroseeded or cyclone seeder is used.**
6. **Apply mulch at the rates specified in “Materials”.**
7. **Anchor mulch as specified.**

C. Sodding

1. **Harrow, disc or otherwise loosen subsoil to a depth of five inches.**
2. **Remove objectionable material such as stones, 1-1/2 inches or larger, clods, brush, roots and trash from top four inches of soil.**
3. **Apply lime and fertilizer at the rates specified in “Materials” and thoroughly mix into the loosened subsoil. Scarify the area and rake until the surface is leveled to provide a maximum of two inches in variation, and the soil is friable and of uniform fine texture.**
4. **Immediately prior to sodding apply additional fertilizer at the rates specified in “Materials” and work into the top two inches subsoil.**
5. **Perform harrowing, discing, scarifying and raking on the contour of slopes steeper than 3:1.**
6. **Moisten sod bed if dry and when directed by the Engineer.**
7. **Deliver sod to the site within 24 hours after being cut and install sod within 36 hours after being cut.**
8. **During wet weather, dry sod sufficiently to prevent tearing during handling and placing. During dry weather, water sod sufficiently before lifting to insure its vitality and to prevent dropping off of soil during handling.**
9. **Sod which has desiccated will be rejected and shall be replaced by the Contractor at no cost to the City.**
10. **Place sod in straight lines parallel to one another. Stagger lateral joints and butt tight. On slopes 5:1 and steeper lay sod with long edges parallel to the contour starting at the top of the slope. In drainage ditches and sodded channels, lay sod with the long edge parallel to the flow of water.**
11. **On slopes 2:1 and steeper and in surface drainage V-shaped or flat bottomed ditches, stake each strip of sod with at least two stakes, spaced not more than two feet apart, or wire staples.**

12. **Immediately upon completion of a section of sodding, roll, tamp, and water until the underside of the sod pad and soil surface beneath it are thoroughly wet and in contact with each other so as to eliminate air pockets.**
13. **Completion of laying, rolling, tamping and watering shall be within an eight hour period.**
14. **Perform sodding between September 15 and May 15.**

D. Mulch Only

Perform grading as required. Place and anchor mulch only at the rates specified in "Materials" where indicated and where directed by the Engineer.

E. Time Restrictions

When permanent seeding or sodding is specified or directed, and seeding is not allowed because of the restrictions specified in "Materials", utilize one or more of the following methods to prevent erosion and sedimentation until such time as permanent seeding or sodding is allowed:

Place and anchor straw mulch

Apply temporary seeding

Prepare soil as for permanent seeding and then mulch as specified; overseed during net seasonal seeding period.

Provide other erosion control measures acceptable to the Engineer and the Sediment Control Inspector.

Remove straw or wood chips used as temporary mulch or work into subsoil to a minimum depth of six inches prior to initiation of permanent seedings application.

F. Maintenance of Seeded and Sodded Areas.

Maintain seeded and sodded areas until accepted in writing by the Engineer.

Water seeded and sodded areas as necessary to maintain adequate moisture in the upper four inches of soil and keep mowed to a height of two to three inches. Do not remove more than 1/3 of the grass leaf during initial mowing. Do not mow sod until it is firmly rooted.

Inspect seeded and sodded areas for failures and necessary repairs.

Provide replacements during the specified planting seasons.

If stand of turf is inadequate as determined by the Engineer, overseed and fertilize using half of the rates originally applied, or resod.

If stand is over 60 percent damaged, as determined by the Engineer, reestablish following original lime, fertilizer, seeder sod bed preparation and seeding or sodding recommendations.

4. Measurement and Payment

A. Seeding and Sodding

Seeding, sodding, mulch, fertilizer, lime, topsoil, preparation of seed to the limits indicated, as directed by the Engineer and as necessary to repair damage caused by the Contractor's operations will not be measured for payment by the square yard.

SECTION 02950

LANDSCAPING

1. General

A. Description

This Section includes provision for tree and shrub planting at locations indicated and approved by the City in accordance with the Contract Documents.

B. Submittals

Submit certificates of compliance before delivery of materials for all materials specified under this Section.

Submit samples of all materials except plants specified under this Section.

Topsoil sample testing shall be performed by a commercial or government agency approved by the City.

C. Reference Documents

Plant measurement size and structure shall be in accordance with the "American Standard for Nursery Stock", latest edition, as published by the American Association of Nurserymen.

"Standardized Plant Names" (1942) by American Joint Committee on Horticulture Nomenclature, shall be the authority for all plant names.

D. Inspection and Acceptance of Plant Materials

Plants shall be subject to inspection and approval at the place of growth or upon delivery for conformity to specification requirements as to quality, size and variety. Such approval shall not impair the right of inspection upon delivery at the site or during the progress of work or right of rejection due to damage suffered in handling or transportation.

Rejected plants shall be removed immediately from the site by the Contractor.

All plants shall be labeled as to genus, species and size and shall bear an inspection certificate from the Board or Department of Agriculture, or other State agency, of the State within which the nursery, where the plants were grown, is located.

E. Plant Replacements

Replace dead, weak, diseased, improperly sized and improperly marked plants not true to name.

All replacements shall be plants of the same type and size as specified in the bid schedule or on the plans and shall carry the same guarantee as the original stock.

If plant rejection occurs, the plants shall be replaced at once. When making plant replacements, replace planting mulch to its original specified depth and follow all procedures outlined in Planting Procedures.

Contractor shall be responsible for watering and care of landscape materials for a period of one year after installation.

2. Materials

A. Topsoil

Topsoil shall conform to requirements of Special Purpose Topsoil as specified in Section 02800. Do not deliver topsoil in frozen or muddy condition.

B. Fertilizers and Additives

Fertilizer for trees and shrubs shall be an organic form such as cotton seed meal or bone meal, or inorganic such as Super Phosphate. Do not use inorganic nitrite or nitrate fertilizers for starter solution in tree or shrub pits.

Super Phosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes, containing not less than 18 percent available phosphoric acid.

Bone Meal shall be commercial raw bone meal finely ground and shall have a minimum analysis in one percent nitrogen and 18 percent phosphoric acid.

Peat Moss shall be a Phagnum peat moss and shall be free from woody substances.

Manure shall be dehydrated, well rooted cow manure.

Anti-Desiccant shall be "Wilt-Pruf" or equal, delivered in manufacturer's containers and used according to the manufacturer's instructions.

C. Soil Mixes

Soil mixes shall be composed of the following materials well-mixed in the specified proportions.

Soil mix for all plants except ericaceous material shall consist of 200 pounds of manure and 36 cubic feet of peat moss to 12 cubic yards of topsoil.

Soil mix for ericaceous plants shall consist of 50 cubic feet of peat moss to 12 cubic yards of topsoil – to which no lime has been added.

D. Planting Stakes and Accoutrements.

Vertical Stakes shall be rough sawn, straight grain oak, reasonably free from knot holes, bar, wane, warp, and splits. Stakes for trees over ten feet shall be 2 inch x 2 inch x 10 feet. Stakes for smaller trees shall be 2 inch x 2 inch x 8 feet.

Guying Stakes shall be of wood of uniform size, free of knot holes and measure 1-3/4 inch x 1-3/4 inch x 30 inches.

Guying Wire shall be pliable Number 12 or 14 gauge galvanized.

Tree Ties shall be 5/8 inch or 3/4 inch reinforced corded garden hose.

E. Mulch

All mulch shall be free of toxic substances or foreign materials that may harm plant life. Mulch for tree and shrub planting and mulch bed construction shall be ground bark, shredded bark or stone chips as indicated.

Ground bark shall be 100 percent true hardwood bark with organic content of not less than 90 percent, with a white wood content not to exceed eight percent and shall be of good uniform brown color. Not more than 50 percent shall be capable of passing through a 3/4 inch sieve.

Shredded bark shall be 100 percent true hardwood bark peelings with organic content of not less than 90 percent. It shall be fibrous material of a good uniform brown color and of which not more than 25 percent shall be able to pass through a 3/4 inch sieve.

F. Water

All water used for planting and maintenance shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life.

G. Herbicide

All herbicides used in mulch beds that will not contain plantings shall be of a non-selective, residual type classified as a pre-plant or a pre-plant/pre-emergence herbicide.

H. Plant Materials

All plants shall be nursery grown unless specifically authorized to be collected. All plants shall be hardy under climatic conditions similar to those in the locality of the project. All plants shall be typical of their species or variety and shall have a normal habit of growth. They shall be sound, healthy

and vigorous, well branched and densely foliated when in leaf. They shall be free of diseases and insect pests, eggs, or larvae. They shall have healthy, well-developed root systems, materials that are weak or which have been cut back from larger grades to meet specifications will be rejected.

All trees shall conform to the Recommended Tree List of the City of Frederick at the end of this section.

All plants shall conform to the measurements specified in the Bid Schedule or on the Plans; with the following exceptions: Plants larger than specified may be used if approved by the City, at no additional cost to the City. If the use of larger plants is approved, the spread of roots or ball of earth shall be increased in proportion to the size of the plant.

Digging and Handling:

1. Bare root shrubs shall be dug with adequate fibrous roots retained and shall be delivered to the site of the project prior to the plant material coming into leaf. Pack roots of these plants in moist straw or peat moss immediately after digging.
2. Balled and burlapped plants shall be dug with firm natural balls of earth, of sufficient diameter and depth to include most of the fibrous roots.
3. Container grown stock shall have been grown in a container long enough for the root system to have developed sufficiently to hold its soil together firmly. No plants shall be loose in the container.

Handling and Protection of Delivered Plants

1. Roots or balls of all plants shall be adequately protected at all times from sun and from drying winds or frost.
2. All balled and burlapped plants which cannot be planted immediately upon delivery shall be set on the ground and shall be well protected with soil, wet straw, peat moss or other acceptable material. Bare root plants which cannot be planted immediately shall be temporarily planted or heeled-in in trenches upon delivery.
3. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent voids among the roots. During planting operations, bare roots shall be covered with canvas, straw or other suitable material. No plant shall be bound with wire or rope at any time so as to damage the bark or break the branches.

I. Low Maintenance Groundcover – Crown Vetch

Seed mix shall be improved turf type tall fescue as listed in the current MDVA Turfgrass Council (University of Maryland). Recommended turfgrass cultivars for sod and seed mixes at 40 lbs. per acre.

Inoculate seed with fresh inoculant as directed on the package. Ensure that crown vetch inoculant contains a sticker supplement.

Maintain temperature of between 50 degrees and 75 degrees during inoculation.

When hydroseeding, use five times inoculant rate.

Other materials including lime, fertilizer, and mulch shall be as specified in Section 02800.

3. Execution

A. Seasons for Planting

Trees and shrubs shall be planted between October 1 and May 15 only. No plants shall be planted during periods of freezing temperatures. Preparations for planting may begin earlier than the specified season, provided locations have been approved by the City.

Ground covers – low maintenance (shall be designated).

B. Planting Procedures

Excavation for tree and shrub pits

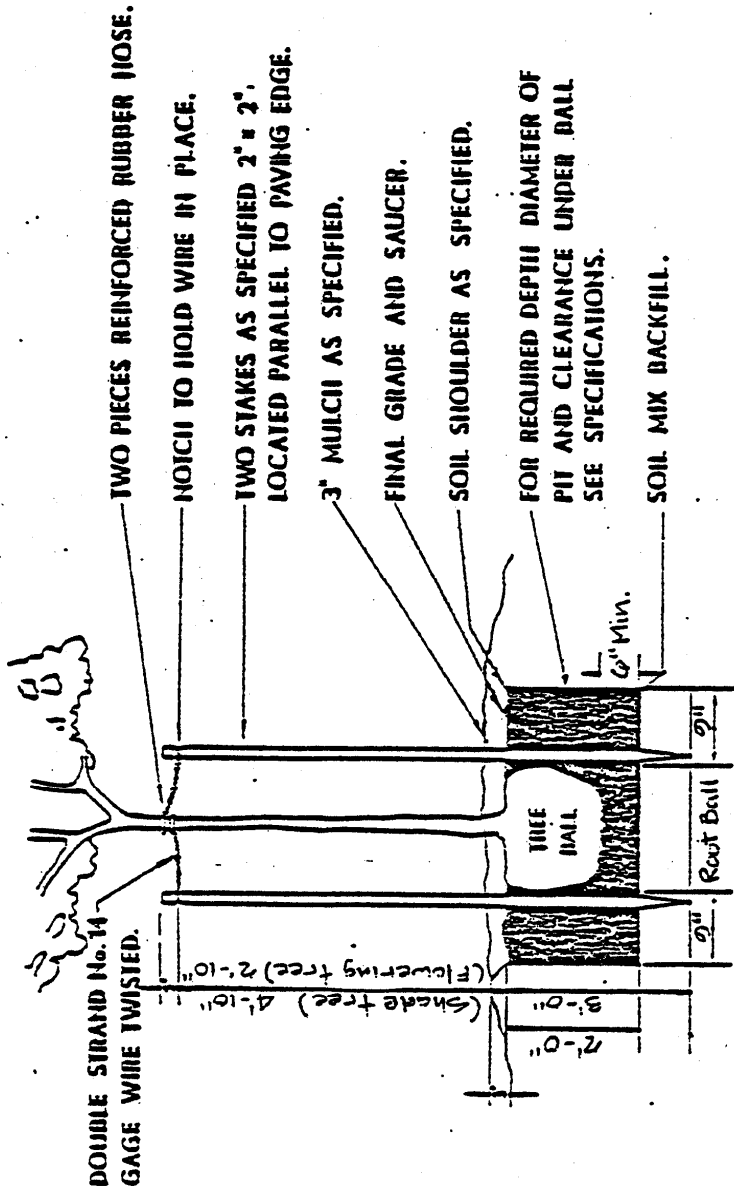
1. **Notify the City prior to beginning plantings operations.**
2. **Provide stakes and stake out the location of all plant pits as shown on the plans and as approved by the City. Do not change locations without the approval of the City.**
3. **Plant all plants in individual pits excavated with vertical sides and horizontal bottom.**
4. **Excavate tree pits two feet greater in diameter than the ball of earth or spread of roots of the tree and sufficiently to allow for a six inch thick layer of the soil mix beneath the ball or roots.**
5. **Plant shrubs in pits 12 inches greater than the spread of the roots and eighteen inches deep below the finished grade, or as necessary to properly set the plant at finished grade.**
6. **Allow a tolerance of one inch for the above dimensions.**
7. **If pits are excavated well in advance of planting, backfill to grade with the specified soil mix, mark locations and record on the plans.**

Planting of Tress and Shrubs

1. **Remove all seals and tags only after inspection and acceptance of plants by the City.**
2. **Set plants in center of pits, plumb and straight, and at such a level that after settlement the crown of the plant will be at the surrounding finished grade.**
3. **After setting balled and burlapped plants, compact soil mix around bases of balls, to fill all voids, up to one-half the depth of the balls, tamp and thoroughly water. Loosen burlap around the top half of the balls and spread out away from the ball. If too bulky, cut burlap away and remove. Remove all balling and tying materials or containers, other than burlap and jute twine, from the pit completely without damage to the soil ball. Cover all burlap and twine with at least two inches of soil mix then fill the remainder of the pit with soil mix, tamp and again water, all within the same day of planting.**
4. **When container grown plants are planted, remove the plant from the container, so as not to damage the root ball and plant as outlined for balled and burlapped plants.**
5. **When bare root plants are set, spread the roots of the plant carefully in their natural positions and work soil mix around the roots, thoroughly tamp into place and water, all within the same day of planting.**
6. **Watering shall mean full and through saturation of all backfill in the pits the day the plants are planted. Apply water by container or open end hose under low pressure only.**
7. **When planted, watered, and fully settled, the plants shall be vertical and the stand shall be flush with stand in the nursery.**
8. **Form a three inch high soil shoulder around the outside of the pit at finished grade, to contain water.**
9. **Mulch all completed plant pits with the specified mulching materials. Spread mulch evenly to a maximum thickness of three inches over the entire area of the pit and for shrubs in beds, the entire area of the shrub bed. Apply mulch within four days after planting.**
10. **Prune each tree and shrub in accordance with the American Association of Nurserymen standards to preserve the natural appearance and character of the plant. Do not cut leaders of shade trees. Remove all dead wood, broken or badly bruised branches, or suckers using only clean, sharp pruning tools.**

Stake all designated trees within 24 hours of the day the trees are planted in accordance with the attached detail. Stakes shall be neat and secure and shall evenly support the trees to true vertical line. In driving stakes, avoid damage to branches. Drive stakes just outside the ball or root-

spread and into solid earth below the pit bottom. Cover guying wires with specified hose material, where in contact with the trunk and branches, and wrap two full turns around the stakes.



DOUBLE STRAND No. 14
GAGE WIRE TWISTED.

TWO PIECES REINFORCED RUBBER HOSE.

NOTCH TO HOLD WIRE IN PLACE.

TWO STAKES AS SPECIFIED 2' x 2',
LOCATED PARALLEL TO PAVING EDGE.

3' MULCH AS SPECIFIED.

FINAL GRADE AND SAUCER.

SOIL SHOULDER AS SPECIFIED.

FOR REQUIRED DEPTH DIAMETER OF
PIT AND CLEARANCE UNDER BALL
SEE SPECIFICATIONS.

SOIL MIX BACKFILL.

Tree Installation

Clean Up After Planting:

1. **Perform clean up as specified in Section GP-4.08 of these Specifications.**
2. **Remove waste materials continuously and promptly.**
3. **Regrade existing turf areas which the City determines have been damaged and seed or sod when so directed, at no cost to the City.**

Low Maintenance Groundcover – Crown Vetch:

1. **Lime soil to produce pH between 6.5 and 7.0, using ground limestone.**
2. **Fertilize soil with 500 pounds of 0-20-20 and 400 pounds of 38-0-0 ureaform per acre.**
3. **Mulch with straw.**
4. **When hydroseeding, proceed, in the following sequence:**
Apply lime and fertilizer.
Apply seed mixture with inoculant.
Apply straw mulch and anchor.

C. Inspections

Initial Inspection and Provisional Acceptance

1. **The City will inspect all or part of the completed planting work for Provisional Acceptance, upon written request from the Contractor. The request shall be presented to the City at least ten days prior to the anticipated date of inspection. All or part of the total landscaping project may be provisionally accepted.**
2. **Upon completion of all repairs or replacements considered by the City, a written notification will be sent to the Contractor notifying him of Provisional Acceptance.**

Final Inspection and Acceptance:

1. **Within ten days of the end of the guarantee period described hereinbefore the City will inspect planting material, upon written notice requesting such inspection, submitted by the Contractor at least ten days before the anticipated date of inspection.**
2. **Upon completion of inspection and concurrence by the City that all materials meet the requirements of the Contract Documents, the City will furnish the Contractor a written notification of Final Acceptance of Landscaping.**

D. Maintenance

Maintenance of planting material shall commence immediately after each plant is planted and shall continue until Final Acceptance. During such time the Contractor shall perform all work necessary to establish and maintain the plants in a live, healthy condition. Maintenance shall include the following:

Watering at the end of each 14 day period, if less than one inch of precipitation shall have been recorded by the National Weather Service in the Metropolitan Area for that period. Each tree pit shall receive at least five gallons of water and each shrub pit shall receive at least two gallons.

Cleaning plant pits of all weeds and grasses. Remove weeds when they have attained a height of four inches. The use of herbicides to control weeds and grasses will be acceptable only if all Maryland Departments of Agriculture regulations are followed.

Pruning of dead material or removal of suckering growth.

Resetting settled plants to proper grade.

Reshaping and remulching of washed out planting pit saucers.

Tightening and repairing of guying and staking apparatuses.

Fertilizing of chlorotic or nutrient deficient plants.

Replacing of dead, weak, or diseased plants.

4. Measurement and Payment

A. Trees and Shrubs

Trees and shrubs shall be measured for payment by each of the various types and sizes actually planted and accepted by the City.

Payment will be made for the quantities measured at the unit prices per each listed in the Bids Schedule.

Payment will include preparatory and maintenance work and all necessary appurtenant materials and equipment.

RECOMMENDED TREE LIST

For approved tree planting list, see City Standard Details L-1, L-1a, L-1b, and Lc

DIVISION 3

CONCRETE

| <u>SECTION NUMBER</u> | <u>TITLE</u> | <u>SHEET</u> |
|-----------------------|--|---------------------------|
| 03300 | CAST-IN-PLACE CONCRETE | 03300-1 To 03300-8 |
| 03480 | PRECAST CONCRETE UTILITY STRUCTURES | 03480-1 To 03480-3 |

SECTION 03300

CAST-IN-PLACE CONCRETE

1. General

A. Description

This Section includes providing normal weight cast-in-place concrete in the sizes and shapes and at the locations indicated, in accordance with ACI 301, as modified and supplemented herein, and in accordance with the Contract Documents.

B. Quality Assurance

Reference Documents:

The Contractor shall obtain and maintain on the site at all times, a copy of ACI 301 and appropriate documents referred to therein.

Testing will be performed by the Engineer or designated representative except where otherwise indicated herein.

Provide visual means of identification of reinforcing steel, size and strength, and welded wire fabric designation, in accordance with CRSI Manual of Standard Practice.

C. Submittals

Submit certified concrete mix designs including proposed admixtures.

Submit certified delivery tickets for concrete showing the following information:

1. **Name and location of batch plant and name of plant inspector.**
2. **Ticket number**
3. **Load number (batch number)**
4. **Date and truck number**
5. **Destination including name and location of City contract.**
6. **Concrete type and class (strength) and design mix designation.**
7. **Actual quantities of all materials including admixtures and amounts of concrete in cubic yards.**
8. **Time at which mixer drum was charged with cement.**

9. **Amount of free moisture by percentage of permissible mixing water in aggregates, plus maximum amount of mixing water which can be added at job site to obtain specified water/cement ratio.**
10. **Blank space for initials of on-site receiving party.**

Submit certified test reports before delivery of materials for approval to the Engineer. The testing shall have been performed in an approved independent laboratory, within one year of submittal of the reports for approval. Test reports shall be accompanied by a notarized certificate from the manufacturer or supplier certifying that the tested material meets the specified requirements and is of the same type, quality, manufacture and make as that proposed to be supplied. Test reports are required for the items listed below:

1. **Admixtures**
2. **Aggregate**
3. **Cement**
4. **Water stop**
5. **Reinforcing and accessories**
6. **Materials for curing concrete**
7. **Joint sealing materials**
8. **Expansion joint fillers**

Submit Shop Drawings as specified in the Section 01102 for the following:

Reinforcing steel prepared in accordance with ACI 315 including bar lists and bending diagrams, placement drawings and special details.

Location, types and details of joints.

Sequence of pours.

2. Materials

A. Reinforcement

Reinforcing bars shall comply with requirements of ASTM A-615, minimum yield strength of 60,000 psi unless otherwise indicated.

Welded wire fabric shall comply with requirements of ASTM A-185, size and spacing of wires as indicated.

Reinforcing accessories shall conform to requirements of CRSI Manual of Standard Practice.

B. Admixtures

Concrete with psi of 3000 and higher shall be air entrained unless otherwise indicated.

Water reducing and retarding admixtures may be used with the permission of the Engineer. Contractor is responsible for the compatibility of admixtures.

The use of calcium chloride will not be allowed without approval.

C. Appurtenant Materials

Vapor Barrier:

Building paper shall be Sisal-Kraft building paper, conforming to requirements of FS-UUB 790A

Polyethylene sheeting shall be 0.006 inch thick, conforming to requirements of ASTM D2103.

Curing Materials:

Curing paper shall conform to requirements of ASTM C171, Type I and shall be flame resistant. Use only non-staining material over all surfaces to remain permanently exposed.

Curing compound shall conform to requirements of ASTM C309, white-pigmented Type II.

Sheet materials for curing shall conform to requirements of AASHTO M-171.

Burlap cloth for curing shall be jute, kenaf or hemp and shall conform to requirements of AASHTO M-182, Class I.

Expansion Joint Filler:

Filler not exposed to traffic or weather shall conform to requirements of ASTM D994.

Filler exposed to traffic and/or weather shall conform to requirements of ASTM D1751 or ASTM D1752.

Temporary wood joint filler shall be straight, sound strips, of width and depth indicated or approved and tapered slightly from face-to back; coated with paraffin, or equivalent, to seal against moisture and to promote ready removal with forms; and shall produce true, straight joint edges.

Joint Sealer:

Sealer hot applied shall conform to requirements of ASTM D1190.

Sealer cold applied shall conform to requirements of ASTM D1850.

Water Stops:

Waterstops for water bearing interior and exterior structures shall be nine inches long three bulb, 3/8 inch minimum diameter rubber or neoprene waterstops conforming to requirements of U.S. Corps of Engineers Specifications CRD-C513.

Waterstops for waterbearing interior and exterior structures shall be nine inches long three bulb, 3/8 inch minimum diameter rubber or neoprene waterstops conforming to requirements of U.S. Corps of Engineers Specifications CRD-C572.

Provide manufactured special accessories at intersections.

Field splices shall be heat sealed and shall be capable of developing water tightness equal to that of unspliced material and shall have tensile strength of not less than 50 percent of unspliced material.

Bonding compound shall conform to requirements of MIL R 19235B.

Coat aluminum accessories and embedded items with an inert compound capable of effecting isolation of the deleterious effect of the aluminum on the concrete.

- D. Cement shall conform to requirements of ASTM C150, Types I and II. Utilize Type III cement only when approved by the Engineer.**
- E. Formwork shall conform with requirements and recommendations of ACI 347. Materials shall be suitable for the use intended and adequate to support loads within tolerances recommended in ACI 347.**

3. Execution

A. Design Mix

Design Strength:

If not indicated otherwise specified 28 days compressive strength of concrete shall be as follows:

4500 psi concrete with M43 size 57 aggregate for all structurally reinforced concrete work.

3000 psi air entrained concrete with M43 size 57 aggregate for exterior work and all flatwork underfoot, such as walks, steps, ramps, drives, porch floors,

all work vulnerable to the use of “de-icers.” Also use for pipe thrust blocking and masonry cell fill.

2500 psi concrete with M43 size 57 aggregate for mud mats, limited site voids, soil boring voids, and for under foundations where excavated to excessive depth.

2500 psi concrete for grout with M43 size 67 aggregate.

Mix Proportioning:

Mix for water, storm drain and sanitary sewer underground structures shall produce watertight concrete resistant to naturally occurring or commonly used chemicals, with a 28 day compressive strength of 4500 psi and shall be performed in accordance with Method I (ACI 301) and the following:

Maintain a maximum water to cement ratio of 0.45.

Provide the following minimum cement content:

| <u>ASTM C33 Coarse Aggregate No.</u> | <u>Lbs. per cubic yard</u> |
|--------------------------------------|----------------------------|
| 467 | 517 |
| 57 or 67 | 564 |

Provide air entrainment as follows:

- 5 ± 1% - coarse aggregate No. 467
- 6 ± 1% - coarse aggregate No. 57 or 67

Maintain slump as follows:

- 1 inch minimum
- 4 inches maximum

Mix proportioning for all other concrete shall be performed in accordance with Method 2 (ACI 301)

B. Formwork Design and Construction

Design, engineering and construction of formwork shall be the responsibility of the Contractor. Shop drawings to be submitted to Engineer for approval.

Chamfer all exposed concrete corners of edges not less than 3/4 inch in each dimension.

Removable form ties will not be permitted in water retaining structures.

Design and construct to support loads in accordance with ACI 347 within the tolerances specified in ACI 301.

Provide form coatings as required to produce desired finish.

Schedule for removal of forms, falsework and centering.

Maintain forms, false work and centering in place until the concrete has attained the minimum percentage of strength listed below in Schedule 1. When approved by the Engineer, values between Schedule 1 and Schedule 2 may be used for removal and shall take into account, where applicable, the following: the ratio of dead load to live load, span, height, shape, ratio of rise to span reshoring, prevailing site conditions.

Minimum Percent of Specified
28 Days Design Strength, f'c

| | <u>Schedule 1</u> | <u>Schedule 2</u> |
|--|-------------------|-------------------|
| Footings; sides of beams, slabs and beams on grade ----- | 25 | 20 |
| Free standing walls, columns and Piers ----- | 50 | 30 |
| Exterior walls, retaining walls, and culverts ----- | 50 | 30 |
| Roofs ----- | 80 | 50 |
| Stairways ----- | 80 | 60 |
| Soffits of beams, slabs and girders under 20 feet clear span between supports ----- | 80 | 60 |
| Over 20 feet clear span between supports ----- | 90 | 70 |
| Cantilevers, canopy ----- | 90 | 70 |

The Engineer will approve removal of the forms, falsework and centering from the types of structural members listed above, and form types not listed providing the concrete has attained the design strengths between Schedule 1 and Schedule 2, and the Contractor meets the following requirements:

Submit to the Engineer calculations showing the concrete strength to be attained at the proposed time of removal of formwork, falsework and centering.

Include in the calculations all loads and the resultant stresses and deformations to which the concrete and reinforcing steel will be subject at the time of removal, and subsequent to the removal, of forms, falsework and centering, until the concrete has attained its design strength.

The concrete strength attained prior to removal of forms, falsework and centering shall be determined from tests of job-cured cylinders which shall be cured under conditions which are not more favorable than the most unfavorable conditions for the portions of concrete which the test specimens represent.

Provide three cylinders per hour or per 1,000 square foot of form contact area, whichever is less, for testing by an independent testing laboratory paid for by the Contractor. Submit a certified test report of these cylinders to the Engineer. Do not start removal of forms, falsework and centering without permission from the Engineer.

Tests shall be in accordance with ASTM C31 except as modified herein.

Subsequent to removal of forms, falsework and centering and prior to attainment of design strength by the concrete, do not alter the loading conditions as to exceed the permissible stresses and deformations at the attained strength of concrete determined as specified herein.

It shall be the responsibility of the Contractor to demonstrate conclusively that the strength of concrete specified has been attained.

The use of earth cuts as forms for small foundations will be permitted provided cuts are vertical, sharp and true.

C. Mixing

Batch mixing will not be allowed without the approval of the Engineer.

D. Placing

Place reinforcement with concrete cover as specified in ACI 318 unless otherwise indicated.

Notify the Engineer before placing concrete. Wet down formwork and reinforcement before placing concrete so as to prevent leeching of water from concrete, but do not allow free water standing in the forms.

Place concrete within 90 minutes after cement has been mixed with aggregate and within 45 minutes after addition of water and admixtures. Discard concrete which has not been placed within these time limits off site. The free drop of concrete shall not exceed five feet without the use of adjustable length pipes.

Locate joints where indicated on the drawings. If not noted, provide control joints as follows:

Provide bond breaker with 1/2 inch expansion joint material at junction of walls, bases and columns.

Provide 1/2 inch expansion joints at changes in direction of slabs, or abrupt changes in width and not greater than twenty (20) feet apart on slabs without control joints.

Seal control joints in exterior slabs.

E. Curing and Protection

Method of curing and protection shall be as specified in MSHA Standard Specifications for Construction and Materials, 1982 and amendments, Section

608.03.08, herein, and in ACI 301 and as set forth elsewhere in the Contract Drawings.

Protect structural floors left exposed to the atmosphere for more than three days by polyethylene covering, dampened burlap, straw or equivalent materials as required to control hydration.

F. Finishes

Method of finishing shall be as set forth elsewhere in the Contract Documents and as specified in ACI 301:

Where not indicated, provide the following finishes:

1. Curbs and equipment bases: **rubbed finish.**
2. Exterior slabs: **broom finish, Class B tolerance.**
3. Interior slabs: **troweled finish, Class A tolerance.**
4. Other concrete not exposed to view: **rough form finish.**
5. Other concrete exposed to view: **smooth form finish.**

G. Removal of Defective Concrete

Concrete not meeting the requirements specified herein shall be removed, disposed of and replaced by the Contractor at no cost to the City.

H. Cold Weather Concreting

Requirements for protection of concrete in cold weather conditions shall be as per American Concrete Institute Section 306.

4. Measurement and Payment

A. Non-Payment Items

Measurement of concrete work for payment will not be made under this Section. Concrete work is considered supplemental material required in the construction of specific items of work that will be measured and paid for under various other items in the Bid Schedule.

SECTION 03480

PRECAST CONCRETE UTILITY STRUCTURES

1. General

A. Description

This Section includes providing precast concrete utility structures including box culverts, storm drain structures, manholes and valve vaults, to the configurations and extents indicated in accordance with the Contract Documents.

B. Quality Assurance

Precast concrete shall be supplied by a qualified firm with a minimum of three years of continuous operations and which has performed at least three representative jobs, three years or older comparable to precast work required for this Contract.

Inspection and Testing:

The Engineer may inspect and test all sections, fittings and joint material upon delivery to the site or at the factory. The supplier shall furnish materials to be tested and labor as required to assist the Engineer with the tests.

Supplier shall provide ample space between rows of stockpiled sections to facilitate adequate inspection.

Supplier shall provide the City Materials Inspector, prior to inspection of sections for an order, with the complete City Contract number, Contractor's name, section sizes and footage or number of pieces required to fill the order.

The supplier shall provide evidence to the City Materials Inspector, prior to inspection, that there is an adequate quantity of sections available of the required sizes and designs for inspection.

Concrete compressive strength shall be determined from compressive tests made on concrete cylinders. Unless otherwise specified, the supplier shall retain an independent testing facility approved by the Engineer for the purpose of molding and testing concrete cylinders in accordance with appropriate ASTM requirements. Furnish results of all tests to the Engineer. The Engineer reserves the right to require core samples of finished products when he deems it necessary.

All concrete cylinders shall be cured under the same environmental conditions as the corresponding box(es).

The supplier shall notify the Engineer at least three working days prior to pouring any structure.

Based upon the above require notice, the City reserves the right to perform random inspections of the manufacture of boxes, vaults, etc. being produced for its ultimate use for the purpose of inspecting the following:

1. **Steel placement**
2. **Steel size**
3. **Overall fabrication**
4. **Workmanship**
5. **And any other general or specific aspect of production and specification compliance.**

C. Submittals

Submit working drawings in accordance with Section 01102 including complete details, pertinent calculations, design loads, materials, strengths, sizes and thicknesses, joint and connection design and details.

Submit shop drawings as specified in Section 01102.

2. Materials

A. Supplemental Specifications

Materials shall be in accordance with Section 03300 as supplemented herein.

Precast-concrete manhole, vault and inlet: Precast concrete manholes shall meet requirements of ASTM C-478 with configurations as shown on the Plans and Standard Details and with joints meeting requirements of ASTM C-443. Furnish in two-foot minimum lengths with manhole as specified in Section 02700.

Precast concrete vaults and inlets shall meet requirements and configurations indicated on the Plans.

Each manhole and precast structure shall be clearly marked on the inside near the top with the following information where applicable: ASTM designation, Standard Detail or Drawing number, station location and designation, date of manufacture and name or trademark of manufacturer.

Precast Concrete Box Culvert:

Precast box culvert sections shall meet requirements of ASTM C-789 and C-850 as modified herein, with configurations as shown on the Plans.

Box sections shall be substantially free of surface roughness. The interior walls shall be substantially a smooth surface and be free from noticeable and harmful ridges, corrugations, elevations and depressions. The finished surface

shall be free of any material which is not an integral part of the compacted concrete such as loose aggregate, cementitious slurry coats, silt, cement and nonrequired markings.

Box sections shall have ends suitable for standard mortar or mastic joints.

Each box culvert section shall be clearly marked on the inside of the side wall at its top section with the following information: span, rise, design table number, design earth cover, ASTM designation, date of manufacture, and name or trademark of the manufacturer.

Gravel Base and Backfill: Gravel base and backfill shall be MSHA No. 4 Stone (Graded Aggregate for Subbase)

Weepholes: Weep holes shall be service weight cast iron covered with non-erodible filter on each side.

3. Execution

- A. Execution shall be in accordance with other applicable sections of this Specification, as supplemented herein:

Provide gravel base and backfill where so indicated on the Plans. Provide weepholes where so indicated on the Plans, placed on base of impervious material. Provide bituminous membrane waterproofing where so indicated on the Plans.

4. Measurement and Payment

A. Precast Concrete Box Culvert

Precast concrete box culvert will be measured for payment by the linear foot of the various sizes actually constructed complete in place, measured along the centerline of the box culvert.

Payment will be made for the quantities of the various sizes measured, at the unit price per linear foot listed in the Bid Schedule.

Payment will include subgrade preparation, gravel base and backfill, weepholes and waterproofing where indicated.

B. Precast Concrete Manhole, Vault and Inlet

Precast manholes, vaults and inlets are measured and paid for under other Sections of these Specifications.

DIVISION 4

MASONRY

SECTION NUMBER

04200

TITLE

MASONRY

SHEET

04200-1 To 04200-9

SECTION 04200

MASONRY

1. General

A. Description

This Section includes providing masonry work above and below grade to the sizes and shapes and at the locations indicated in accordance with the Contract Documents.

B. Submittals

Samples:

Sample wall panels for above grade work:

Before installation of masonry wall, erect at the job site sample wall panels four feet high and wide for each type of wall required. Panels shall show the proposed color range, texture, bond, mortar joint and workmanship of masonry materials. Provide separate panels for facing brick and glazed masonry units as composite wall, and glazed concrete block masonry unit partitions. Do not proceed with masonry wall work until the Engineer has approved the sample panel for the work involved. The approved panels shall become the standard of comparison for all masonry work built of the materials that the approved panels include. Do not alter, move or destroy the panels until all masonry work is complete.

Sewer and manhole brick samples: submit at least five bricks prior to purchase and delivery of each type required. Do not purchase brick until the Engineer has approved the samples.

Concrete block samples: Submit at least five blocks of each type required prior to purchase and delivery. Do not purchase blocks until the Engineer has approved the samples.

Reinforcement Accessories: Submit two samples of each type of wall reinforcement anchor, wall ties and other accessories to the Engineer for approval.

Provide samples cubes of mortar to the Engineer as directed.

Submit certified test reports before purchasing materials for all materials furnished under this Section.

Submit certificates of compliance before delivery for prepackaged mortar mix.

Submit shop drawings as set forth in Section 01102 for reinforcing and lintels.

C. Delivery and Storage

Deliver cement, lime and other cementitious materials to the site and store in unbroken bags, barrels or other approved containers, plainly marked and labeled with the manufacturer's names and brands. Store mortar materials in dry, weathertight sheds or enclosures, and in such a manner as will prevent the inclusion of foreign materials and damage by water or dampness. Handle masonry units so as to avoid chipping and breakage. Materials stored on newly constructed floors shall be stacked in such a manner that the uniformly distributed loading does not exceed 50 psi.

2. Materials

A. Brick

Brick shall match samples on file in the Engineer's Office

Facing brick shall conform to the requirements of ASTM C216, grade SW, Type FBS. Exposed face shall contain no visible cracks.

Common brick shall meet requirements of ASTM C62, grade SW, Type FBS where exposed to weather or in contact with the earth and grade SW or MW, Type FBS for other locations. Average dimensions shall be within the range of 2-1/8 to 2-1/2 inches high, 3-3/8 to 4 inches thick, and 7-1/2 to 8-1/2 inches long.

Sewer and manhole brick shall meet requirements of ASTM C32 and shall have a high and uniform degree of resistance to frost action in the presence of moisture. Bricks used for channel lining shall be sewer brick Grade SM. All other brick utilized in water, sewer and storm drain structures and manholes shall be manhole brick, Grade MS.

B. Concrete Block

General:

Concrete block units shall be made from Portland cement and clean, well-graded aggregates, free from dust or other injurious matter, and shall be thoroughly seasoned, whole, sound and free from cracks or other defects that interfere with the proper placing or impair the strength or permanence of the construction.

Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide a suitable bond; elsewhere, exposed surfaces of units shall be comparatively smooth and of uniform texture.

Hollow Load-Bearing Units shall conform to requirements of ASTM C90; grades N-I units shall be provided for exterior and foundation walls; grades N-I, or N-II or S-I or S-II Units shall be provided for other load-bearing walls and partitions.

Hollow Non-Load Bearing Units shall conform to requirements of ASTM C129 Types I or II for interior non-load-bearing walls and partitions, except that load-bearing units may be provided in lieu of non-load-bearing units.

Solid Load-Bearing Units shall conform to requirements of ASTM C145, Grades S-I or S-II, except that units exposed to weather shall be Grades N-I or N-II. Solid units shall be provided for masonry bearing under structural framing members as indicated.

Special shapes, such as closures, header units and jamb units, shall be provided as necessary to complete the work and shall conform to the applicable portions of the Specifications for the units with which they are used.

Glazed Concrete Masonry Units shall be lightweight concrete block, with finished and exposed surfaces covered at point of manufacture with a compound containing at least 75 percent graded silica sand, cast onto base block by an external heat-polymerizing process. Block shall conform to requirements of ASTM C90 and C129 for load-bearing and non-load-bearing units.

Facing material shall conform to requirements of ASTM C129, Grade G with respect to imperviousness, resistance to fading (chemical resistance), opacity and tolerances on dimensions, and when tested as per ASTM E84, shall have a flame spread index and other fire characteristics as per local requirements. Units tested for shrinkage in accordance with ASTM C246 shall be free from crazing. The facing shall return over ends and edges of the block, forming a lip at least 1/16 inches thick, resulting in a 1/4 inch exposed mortar joint. When tested for abrasion, the facing shall have a wear factor not in excess of 130 in accordance with FS 141A/0192, using a standard Taber Abraser Model with CS 17 calibre wheel and a 1,000 gram weight of 500 wear cycles.

The glazed surface shall be free from chips, cracks, pinholes, and other imperfections detracting from the appearance of the finished wall when viewed at five feet, at right angles to the wall.

Sound Absorbing Structural Masonry Units shall conform to requirements of ASTM C90 and C129 for load-bearing and non-load-bearing units. Units shall have one end of the cavities tightly closed. Slots and edges shall be straight and clean. Specially fabricated filler elements of incombustible fibrous material shall be factory installed. Where indicated, fillers shall have metal septa laminated to one side of the fibrous material and installed with the septa facing away from the slots. Where indicated, install metal septa without fibrous material. Sound absorption qualities shall meet the criteria specified in the Special Provisions, with Noise Reduction coefficient determined in accordance with ASTM C423.

Units for manholes and catchbasins shall conform to requirements of ASTM C-139.

Admixtures will not be allowed without the approval of the Engineer.

C. Accessories

Oakum and caulking compound as required for the proper installation of all concrete block masonry shall be as approved by the Engineer.

Horizontal Joint Reinforcement shall be fabricated from cold-drawn steel wire, conforming to requirements of ASTM A82. The wire shall be zinc-coated after fabrication by the hot-dip process in accordance with ASTM A153 either bright steel, copper-clad steel, or zinc-coated after fabrication. Reinforcement shall consist of two or more parallel longitudinal wires: Heavy duty shall have longitudinal wires 0.1875 and cross wires 0.1350 inches in diameter, Standard shall have long and cross wires 0.1483 inches in diameter, weld connected with cross wires. Cross wires shall be crimped to provide an effective moisture drip in wall cavity. The out-to-out spacing of the longitudinal wires shall be 1-1/2 to 1-3/4 inches less than the actual width of the masonry. The distance between welded contacts of cross wires with each longitudinal wire shall not exceed 16 inches. Joint reinforcement shall be provided in flat section, not less than ten feet in length, except that corner reinforcement and other special shapes may be less in length.

Anchors and ties shall be of approved designs, and shall be of copper-clad steel, zinc-coated steel, or non-corrosive metal having the equivalent total strength of steel types. Zinc-coated items shall be coated by the hot-dip process after fabrication. Zinc-coated items shall have a minimum of 1.25 ounces of zinc per square foot of surface when tested in accordance with ASTM A90.

Wire mesh ties shall consist of wire, not less than 0.0625 inches in diameter, in 1/2 inch mesh, and of suitable width and length.

Corrugated metal ties shall be not less than 7/8 inches wide by approximately seven inches long and not lighter than 18 gage.

Rigid steel anchors shall be not less than one inch wide, 3/16, 1/4 inches thick and 18, 24 inches long between bent ends. Each end shall be bent down not less than three inches into the mortar filled cells.

Fastening including suitable bolts, metal wall plugs or other approved metal fastenings shall be provided for securing furring to masonry and elsewhere as necessary.

Through wall flashing shall be copper or corrosion resistant steel flashing and shall be provided with factory fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Such deformations shall consist of dimples, diagonal corrugations or a combination of dimples and transverse corrugations. Copper flashing shall be six-ounce weight conforming to requirements of FS-QQ-C-576. Corrosion resistant steel shall be 0.006 inch thick, conforming to requirements of ASTM A167, sheet or strip, Type 301, 302, 304, or 316, with a No. 2D or No. 2 finish sheet and strip respectively.

3. Execution

A. Environmental Conditions

General:

Cover completed work each day to prevent rain or melting snow from penetrating the mortar of upper course. Do not uncover until immediately before new work is to be laid. Protect new masonry for a period of not less than 72 hours immediately following laying. This time period may be extended by the Engineer.

Spray masonry laid during the period from April to November, inclusive, with sufficient water so as to be moist, but not saturated with water just prior to use.

Cold Weather:

Do not lay masonry when the air temperature is below 40 degrees Fahrenheit on a falling thermometer, or when it appears probable that temperatures below 40 degrees will be encountered before the mortar has been set, unless adequate means approved by the Engineer are provided for protecting the work from freezing. Protect work by heating and maintaining the temperature of the masonry materials at not less than 40 degrees but not more than 160 degrees and maintaining an air temperature above 40 degrees on both sides of the masonry for not less than 72 hours. Work will not be permitted with or on frozen materials. Masonry work may be started at 34 degrees on a rising thermometer, with the approval of the Engineer. When the temperature reaches or is above 40 degrees proceed as under warm weather conditions. However, protect the new work against freezing weather for a period of 72 hours after the masonry is laid.

Hot Weather:

During hot weather, protect masonry from direct rays of sun. Cover, and/or wet all finished work for a period of seven days after laying.

B. Mortar

Mortar proportions for laying up concrete block throughout the work shall be of the following types in accordance with ASTM C270: For foundation walls, and work below grade, Type M. For all other masonry work, Type S.

Mix mortar in a mechanically operated batch mixer of the drum type. Hand mixing will be permitted provided the quantities of materials and water are accurately measured and provided that the method of mixing is approved by the Engineer. Thoroughly mix cement, lime and sand dry, and then mix for at least four minutes after adding water. Do not use mortar that has obtained its initial set or has been mixed for longer than 45 minutes.

Mortar for parging masonry walls below grade shall be composed of one part Portland cement, 1/4 part hydrated lime and three parts sand.

Grout shall consist of a mixture of cementitious materials and aggregate as specified hereinafter; water shall be added in sufficient quantity to produce a fluid mixture. Fine grout shall be provided in grout spaces less than two inches in any horizontal dimension or in which clearance between reinforcing and masonry is less than 3/4 inch. Coarse grout shall be provided in grout spaces two inches or greater in all horizontal dimensions and where clearance between reinforcing and masonry is not less than 3/4 inch.

Fine grout shall be mixed in proportions of one part Portland cement, 1/4 part lime past and three parts sand.

Coarse grout shall be mixed in proportions of one part Portland cement, 1/4 part lime paste, three parts sand and three parts pea gravel passing a 3/8 inch sieve.

C. Placing

Workmanship:

Lay masonry plumb, true to line, with level and accurately spaced courses with reveals and corners plumb and true, and each joint staggered half joint distance from the course below. The height of all courses shall be determined by the use of a story rod. Joints shall be 3/8 inch unless otherwise indicated.

Build chases and opening for pipes and castings and build in pipes and castings as indicated on the Plans and Standard Details or as directed. Provide waterproof joining.

Cut masonry around frames in the best possible manner, and flush up interstices between masonry and frames solid with mortar. Do not break concrete block wall units with hammers or other tools. Cut, where required, with an electrically operated carborundum saw.

Build in wood blocking, adjustable wall furring anchors, strips, grounds, wedges, pipe sleeves, frames and similar items of material necessary to properly secure the work for other trades.

Remove mortar which has splashed or been smeared on finished surfaces with stiff bristle brushes as the work progresses. Provide jamb units of shapes and sizes required to blend with wall units.

Lintels:

Provide lintels for all opening heads in masonry walls, of reinforced precast concrete or of concrete masonry units filled with concrete, plus steel angles to support exterior brick where required.

Reinforced precast concrete lintels unless otherwise indicated shall be eight inches high and the thickness of the wall, reinforced with two No.5 reinforcing bars unless indicated otherwise. Provide a minimum of six inches of bearing at each end.

Exposed work shall be of the same material and texture as the adjoining masonry units. Build lintels on the ground and allow to set at least six days before being moved.

Bond beams and lintels formed of concrete masonry units shall have the cells filled solidly with grout and concrete. Provide not less than two No. 5 reinforcing bars, unless indicated otherwise. Lap reinforcing a minimum of 24 bar diameters at splices. Break bond beams and reinforcing at control joints.

Reinforcing:

Provide welded wire tie reinforcement where indicated in every other course and in the two courses above and below openings in walls of concrete masonry units. Reinforcement shall be continuous, except that it shall terminate on each side of control joints. Extend reinforcement above and below openings not less than 24 inches beyond each side of openings. Provide reinforcement in the longest available lengths, utilizing the minimum number of splices. Overlap splices not less than 12 inches. Provide special form pieces with the same size members at the corners and intersections of walls. Tie intersections of non-load bearing partitions with corrugated metal anchors at maximum intervals of two feet, or bond alternate courses. Embed reinforcement in the mortar joints so that all parts will be protected by mortar.

Parging:

Parge exterior masonry in contact with the earth with two coats of Portland cement mortar, each 3/8 inch thick. The first coat shall be cross-scratched; the second coat shall be troweled smooth, beveled at the top and coved out at the edge of the footing. Extend parging not more than eight inches above grade, unless indicated otherwise, and keep damp for at least three days.

Flashing:

Provide through-wall flashing as indicated. Unless indicated otherwise, extend flashing from a point 1/2 inch from exterior face of walls, upward across wall cavity into mortar of bed joint for backing wythe. Terminate 3/4 inch back from interior face of walls and turn back on itself not less than 1/2 inch. Firmly secure flashing to provide a watertight joint as indicated. Provide flashing in lengths as long as practicable. Lap-ends not less than 1 1/2 inches for interlocking type ends and four inches for other types which require cementing to provide watertight construction.

Voids Filled with Grout:

Perform grouting from the interior side of walls, except as approved otherwise. Protect sills, ledges, offsets and other surfaces from grout droppings; grout falling on such surfaces shall be removed immediately. Stir grout well before placing to avoid segregation of the aggregate. Assure that grout is sufficiently fluid to flow into joints and around reinforcing without leaving voids. Place grout by pumping or pouring from buckets equipped with spouts, in lifts not exceeding four feet. Keep pours 1-1/2 inches below the top of masonry units in top course, except at the finish course. "Float" bricks into grout to a position within not less than 1/2 inch nor more than two inches of grout surrounding

bricks. Puddle or agitate grout thoroughly to eliminate voids without displaced masonry from its originally position. Remove masonry displaced by grouting operation and lay in realignment with fresh mortar.

Brick:

Lay brickwork in common bond. Fill all joints between bricks completely with mortar. Form bed joints with a thick layer of mortar, which shall be smoothed. Form head joints by applying to the brick to be laid, a full coat of mortar on the entire end, or on the entire side, as the case requires, and then shoving the mortar-covered end or side of buttering at the corners of brick and then throwing mortar or scrapings into the empty joints will not be permitted. Lay closer brick with a bed joint and with head joints. Place the brick carefully without disturbing the brick previously laid. Properly bond each course of load-bearing masonry wall and exterior wall at corners and intersections. Dry or butt joints will not be permitted. Provide grouting where indicated.

Brick-Faced Walls:

Brick-faced walls shall consist of backing of concrete masonry units, faced with brick. Bond the facing and the backing in every seventh course with brick headers overlapping or extending not less than four inches into a recessed portion of backing units. Use bats only for closures. At the Contractor's option, anchor the facing and backing with metal ties at the rate of one tie to each 4-1/2 square feet of wall surface, staggered in alternate courses, and spaced vertically not over 18 inches and horizontally not over 36 inches. Provide additional bonding ties spaced not more than three feet apart around the perimeter and within 12 inches of the opening at all openings.

Fill collar joints in solid brick or brick-faced walls by parging the back of the facing or the outside face of the backing with a uniform trowel coat of mortar, not less than 3/8 inch thick. Apply parging so that the alignment and the bond of the masonry units will not be disturbed. Filling collar joints by slushing will not be permitted.

Construct brick sills as follows: Lay brick on edge, sloped and projected not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

Concrete Masonry Unit Work:

Lay the first course of concrete masonry units in a full bed of mortar for the full width of the unit. Lay succeeding courses with broken joints. Form bed-joints by applying the mortar to the entire top surface of the inner and outer face shells. Form head joints by applying the mortar for a width of about one inch to the ends of the adjoining units laid previously. The mortar for joints shall be smooth, not furrowed, and shall be of such thickness that it will be forced out of the joints as the units are being placed in position. Where anchors, bolts, and ties occur within the cells of the units, fill such cells with mortar or grout as the work progresses. Use concrete brick for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers and elsewhere as required.

Provide control joints where indicated of the sawed type, or built in type, as the case requires. Fill joints with a properly formed synthetic rubber or vinyl plastic sealing strip as indicated.

Lay sound absorbing structural masonry units with the open ends of the cavities facing downward in a full bed of mortar. Expose the slots to the area where sound absorption is required. Keep slots free of mortar and debris above the mortar joints.

Masonry Work for Utility Structures:

Use sewer brick wherever brick construction is exposed to flow; otherwise use manhole brick or concrete block. Lay sewer brick on edge so that the 2-1/4 x 8 inch side is exposed to the flow.

Lay manhole brick so that every sixth course is a header course.

Lay concrete block as specified hereinabove.

Where practicable, lay each course with a line. For courses curved or in non-parallel planes, use bonded and keyed brick construction. Do not exceed a joint thickness of 3/8 inch in straight courses in parallel planes; for courses curved or in non-parallel planes, make the thickest part of the joint as thin as practicable.

Rack or tooth uncompleted brick and block construction and parge nonexposed surfaces with 1/2 inch of mortar.

D. Finishing

Clean exposed masonry. At completion of the masonry work, point holes in exposed masonry and cut out defective joints and tuck joint solidly with mortar. Thoroughly wet exposed surfaces of exterior and interior brickwork with clear water and scrub with a solution of not more than one part muriatic acid to nine parts of water, applied to an area not over 15 to 20 square feet at a time, with a stiff fiber brush. Immediately after cleaning, rinse each area thoroughly with clear water. Protect work which may be damaged, stained, or discolored during the cleaning process. Restore work that is damaged, stained or discolored to its original condition, or replace, at no cost to the City.

4. Measurement and Payment

Measurement of this work for payment will not be made under this Section. Masonry work is considered supplemental material required in the construction of specific items of work that will be measured and paid for under various items in the Bid Schedule.

DIVISION 5

METALS

| <u>SECTION NUMBER</u> | <u>TITLE</u> | <u>SHEET</u> |
|-----------------------|-----------------------------|---------------------------|
| 05120 | STRUCTURAL STEEL | 05120-1 To 05120-5 |
| 05500 | MISCELLANEOUS METALS | 05500-1 To 05500-9 |

SECTION 05120

STRUCTURAL STEEL

1. General

A. Description

This Section includes providing structural steel work as indicated in accordance with the Contract Documents

B. Quality Assurance

Field welds will be inspected by the Engineer in accordance with selected methods from AWS D1.1.

Field assembled bolt construction will be inspected by the Engineer in accordance with AISC Specifications for Structural Joints using A325 or A490 bolts.

C. Submittals

Submit shop drawings in accordance with Section 01102 including the following:

Complete information necessary for the fabrication of the component parts of the structure or structures, including location, type and size of all bolts and welds, both shop and field. Indicate welds by standard welding symbols of the AWS.

Erection plans and details indicating required sequence of construction where applicable.

Surface finishes, paint system or other coating.

Submit certified test reports as specified in Section 01103 before delivery of materials for all materials supplied under this Section.

D. Delivery and Storage

Material shall be handled, shipped and stored in a manner that will prevent distortion or other damage. Material shall be stored in a clean, properly drained location out of contact with the ground. Damaged material shall be replaced or repaired in an approved manner at no cost to the City.

Mark weight on all members.

Match mark all shop prefitted members.

E. Design Criteria

Design of connections not shown on the plans shall be in accordance with requirements of “Specifications for the Design, Fabrication & Erection of Structural Steel for Buildings” of the AISC. Submit calculations with the shop drawings showing such connections.

2. Materials

A. Structural Steel

General Requirements for rolled steel plates, shapes and bars, shall conform to requirements of ASTM A6.

Carbon steel plates, shapes and bars shall conform to requirements of ASTM A36.

High strength structural steel shapes, plates and bars shall conform to requirements of ASTM A440.

Weathering steel shall conform to requirements of ASTM A588.

B. Bolts, Nuts and Washers:

Bolts, nuts and washers shall meet requirements of ANSI B18.21 and B18.22 and the following:

Low carbon steel bolts and nuts shall conform to requirements of ASTM A307.

High strength carbon steel bolts, nuts and washers for structural joints shall conform to requirements of ASTM A325.

Round washers other than those in contact with high strength bolt heads and nuts shall conform to requirements of ANSI B27.3, Type B.

Beveled washers shall be square, smooth and sloped to make contact surfaces of bolt head and nut parallel.

C. Structural Steel Tubing

Structural steel tubing in rounds and shapes shall conform to requirements of ASTM A501, round, square, rectangular or special-shaped.

D. Galvanizing

Products fabricated from rolled, dressed and forged steel shapes, plates and strip shall conform to requirements of ASTM A123.

Iron and steel hardware shall conform to requirements of ASTM A153.

Hot dip coating on assembled steel products shall conform to requirements of ASTM A386.

Prime coat for galvanized surfaces shall conform to requirements of FS-TT-P-641, Type I.

E. Shop Paint

Shop paint for structural steel shall meet one of the following requirements:

Paint, 3 mil thickness shall be one of the following:

Alkyd base, ready mixed paint system conforming to requirements of AASHTO M-72, Type III or

Titanium lead zinc, ready mixed paint system, conforming to requirements of FS-TT-P-86.

Prime, 1 mil thickness shall be one of the following:

Zinc chromate conforming to requirements of FS-TT-P-645 or

Red lead paint conforming to requirements of Type I or Type II, FS-TT-P-86.

Asphalt varnish conforming to requirements of FS-TT-V-51F.

Paint and prime shall be compatible.

F. Welding

Welding shall meet requirements of AWS D1.1.

G. Coating

Coating for steel exposed to earth shall be in accordance with MIL-P-23236P.

3. Execution

A. Fabrication

Fabricate and shop assemble work in accordance with ASCI Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, Specifications for Architecturally Exposed Structural Steel, Specification for Structural Joints using ASTM A325 or A490 Bolts, AASHTO Standard Specifications for Highway Bridges, and in accordance with AREA Specifications for Steel Railway Bridges, where applicable.

Straighten rolled material, if necessary, before it is laid out for fabrications, in a manner conforming to the mill tolerances provided in ASTM A6, and by a process and in a manner which will not injure the material. Sharp kinks and bends will be cause for rejection of the material. Heat shrinking of low-alloy structural steel will not be permitted.

Perform shearing, flame cutting, and chipping carefully and accurately. Cut flame-cut edges of members subjected to dynamic loading by a mechanically guided torch or by hand, and remove all nicks. The radii of reentrant gas-cut fillets shall be not less than 3/4 inch and as much larger as practicable. Perform flame cutting in such manner that metal being cut is not carrying stress. Finish exposed edges flame-cut by hand, by grinding.

Provide holes for connection of the work of other trades.

Weld in accordance with requirements of AWS D1.1. Weld all shop connections unless otherwise indicated.

Shop paint all structural steel except zinc coated surfaces, surfaces to be imbedded in concrete or mortar, steel piles or steel for temporary construction. Remove oil, grease and loose mill scale. Clean surfaces to be painted in accordance with SSPC-SP-3.

Prime to one mil thickness within 24 hours after cleaning. Apply asphalt varnish to surfaces which will be concealed after construction and require no over-painting.

Caulk small cracks, cavities and open seams with a pasty mixture of red lead and linseed oil. Allow to dry before applying full shop coat.

Strip paint edges, corners, bolts, and welds and allow to dry before applying full shop coat.

Apply shop coat to a wet film thickness of three mils to dry metal. Paint to within three inches of welds prior to welding.

Paint erection marks for identification with a contrasting color after shop coat has dried.

B. Erection

General:

Erection shall be in accordance with AISC Manual of Steel Construction as modified herein. Erect steel members true and plumb following match marks. Thoroughly clean surfaces to be joined.

Assemble joints using high strength steel bolts, unless other bolts are indicated, in accordance with the AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts". Perform field welding in accordance with AWS D1.1.

Do not make or enlarge holes by burning.

Provide temporary bracing sufficient to handle construction loads.

Field Assembly:

Splice only where indicated.

Align and adjust members forming parts of a complete assembly after assembly and before fastening. Should parts not fit, notify the Engineer immediately.

Field paint exposed surfaces of steel work in accordance with requirements specified elsewhere herein.

4. Measurement and Payment

Measurement of structural steel work for payment will not be made under this Section. Structural steel work is considered supplemental material required in the construction of specific items of work that will be measured and paid for under various other items in the Bid Schedule.

SECTION 05500

MISCELLANEOUS METALS

1. General

A. Description

This Section includes providing miscellaneous metal items including all anchors, fasteners, hardware and accessories necessary to complete the work as indicated, in accordance with the Contract Documents.

B. Submittals

Submit shop drawings in accordance with Section 01102 showing the following:

Sizes, finishes, all materials, locations, attached hardware and fittings and details for all items and fabricated metal work, threaded fasteners and welds. Indicate all welds, both shop and field, by symbols conforming to AWS Standards.

Furnish setting diagrams, erection plans, templates, and directions for the installation of backing plates, anchors, and other items.

Submit catalogue descriptions of manufacturer's standard items.

C. Delivery, Handling and Storage

Identify, and match mark if applicable, all materials, items and fabrications, for installation and field assembly.

Whenever practicable, deliver items to job site as complete units, ready for installation or erection, with all anchors, hangers, fasteners and miscellaneous metal items required for installation.

Provide adequate storage facilities at the job site for the protection and storage of all delivered materials. Handle and store in such a manner as to not damage factory finishes. Repair damaged finishes at no cost to the City.

2. Materials

A. Standard Items

Whenever practicable, items shall be standard products, meeting the requirements specified herein, of a manufacturer regularly engaged in production of such items.

B. Shapes and Bars

Mild steel shall conform to requirements of ASTM A36, unless otherwise indicated.

Corrosion resistant steel shall conform to requirements of ASTM A242, 0.25 to 0.75 copper.

Stainless steel shall conform to requirements of ASTM A276, Type 304.

Aluminum shall conform to requirements of ASTM B221.

C. Plate, Sheet, Strip

Mild steel shall conform to requirements of ASTM A36, or A283, Grade C.

High strength steel shall conform to requirements of ASTM A242.

Corrosion resistant steel shall conform to requirements of ASTM A242; 0.25 to 0.75 copper.

Stainless Steel:

1. **Over 1/8 inch shall conform to requirements of ASTM A264 with ASTM A240, Type 304 or ASTM A36 base.**
2. **Under 1/8 inch shall conform to requirements of ASTM A167, Type 304.**

Aluminum shall conform to requirements of ASTM B209.

D. Mild Steel Forgings

Mild steel forgings shall conform to requirements of ASTM A235, Class F.

E. Castings

Grey iron shall conform to requirements to ASTM A48, Grade 35.

Malleable iron shall conform to requirements of ASTM A47, Grades 35018.

Ductile iron shall conform to requirements of ASTM A536, Grades 60-40-18.

Nodular iron shall conform to requirements of ASTM A220, Grade 45008.

Steel shall conform to requirements of ASTM A27, Grade 65, 35.

Aluminum shall conform to the requirements of ASTM B108, Allot 356.0, Tc.

F. Pipe and Tube

Mild Steel:

Welding shall conform to requirements of ASTM A53, Type S, Grade B, schedule 40, black. Provide schedule 80 for handrail posts.

Screwed connections, shall conform to requirements of ASTM A120 or ASTM A53, Type E or S, Grade B, schedule 40. Provide schedule 80 for handrail posts.

Stainless:

Welding shall conform to requirements of ASTM A312, Grade TP-204L, schedule 105 minimum.

Screwed connections shall conform to requirements of ASTM A312, TP 304, schedule 405.

Press fits shall conform to requirements of ASTM A312, Grade TP 304, schedule 55 minimum.

Aluminum shall conform to requirements of ASTM B221, Alloy 6061.

G. Bolts, Nuts, Washers

General:

Provide galvanized for use with galvanized material.

Provide stainless for use with corrosion resistant and stainless materials.

Provide cadmium plated for use with all other materials.

Stainless:

Bolts shall conform to requirements of ASTM A193, Grade B8, Type 2.

Nuts shall conform to requirements of ASTM A194, Grade 8.

Washers shall conform to requirements of ASTM 290, Type 304.

Expansion bolts shall be metal shield type.

Steel drive bolts shall be the split shank type.

Headed steel anchors shall be fabricated from the cold finished carbon steel conforming to requirements of ASTM A108.

H. Checkered Safety Plate

Steel shall conform to requirements of FS-QQ-F-461, Class K, flat back, standard four-way raised pattern, rolled from ASTM A36, Grade A, thickness and span for 16 ksi maximum fiber stress.

Aluminum shall conform to requirements of ASTM B221, Allow 6063-T6.

I. Safety Treads

Shall conform to requirements of FS-RR-T-650, Type C.

J. Grating

Steel shall conform to requirements of ASTM A36, 4.0 pound class minimum.

Expanded metal shall be standard diamond.

Bar shall conform to requirements of FS-RR-G-661, Type 1.

Plant shall conform top requirements of FS-RR-G-1602, Type 1.

K. Castings

Shall be grey iron meeting requirements of ASTM A48, Class 35 unless otherwise indicated.

L. Paint and Coatings

Where indicated, shop paint miscellaneous metal items. Provide paint systems to the Engineer for approval. Field painting, if required, shall be as approved by the Engineer.

Metal Coatings:

Galvanized sheet shall conform to requirements of ASTM A446. All other galvanizing shall conform to requirements of ASTM A123 or ASTM 153 or both ASTM 385 and ASTM 386, as applicable.

Cadmium shall conform to requirements of ASTM A165, Type NS.

Galvanize touch up shall be zinc dust coating conforming to requirements of MIL-P-26915.

Bituminous corrosion protection shall conform to requirements of MIL-P-23236-P, Class 2.

Coat aluminum accessories and items embedded in concrete with an inert compound capable of effecting isolation of the deleterious effect of the aluminum on the concrete.

3. Execution

A. Fabrication

General:

Fabricate all work as indicated in the Contract Documents and approved shop and working drawings. Straighten work bent by shearing or punching.

Press exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded. Construct connections and joints exposed to weather to exclude water.

Provide sufficient quantity and size of anchors for the proper fastening of the work.

Fabricated Products:

Pipe sleeves in concrete construction shall be standard weight, black steel pipe, with anchors welded to exterior, size as required to accommodate passage of conduits, pipes, ducts and similar items with proper clearance.

Railings:

Fabricate railings and handrails as indicated in accordance with OSHA from aluminum alloy or steel, hot dip galvanized after fabrication.

Fabricate pipe handrails with all intersections and joints neatly fitted, fully welded and ground smooth and flush. Heat and bend smoothly, without distortion. Fabricate posts and stand-offs for pipe railing of the same material as the railing, evenly spaced as shown, with anchor flanges. Handrails along walls shall return to the wall at ends with quarter round bends and welded flanges.

Fabricate flanges for posts from 3/8 inch minimum thickness plate, and for stand-offs from not less than 3/16 inch thickness plate. Coat contact side of flanges with bituminous corrosion protection.

For fastening aluminum pipe railing and handrails, use stainless steel stud bolts with heavy aluminum washers and nuts. For fastening steel pipe railing and handrail use galvanized high tensile strength stud bolts, nuts and washers.

Trench Covers:

Provide checkered safety plate not less than 1/4 inch thick, having accurately formed steel angle frames, with provisions for firm anchorage to structural floor or curb. Cut plates to convenient lengths for handling, and provide finger holes for lifting.

Metal Stair Systems, Ladders and Cages:

Fabricate metal stair systems and landings from structural shapes and plate with a minimum clear width in no case less than 22 inches with a rise angle between 30 and 50 degrees and with a rise to tread run conforming to Table D of OSHA (1910.24) 31.4806. Provide treads and platforms with a non-slip surface.

For metal stairs at angles greater than 45 degrees provide open riser type with open grating type threads.

For galvanized metal stair systems provide solid treads of checkered safety plate and landing kick plates of four inches high by ¼ inch thick plate.

For permanent ladders; fixed type provide all steel and all welded construction galvanized designed, fabricated, and installed in accordance with OSHA (1910.27) 31.4815-7 requirements for fixed ladders.

Backing Plates:

Provide 16-gauge minimum galvanized steel backing plates as necessary for installation of lavatories, fixtures, equipment and all other items requiring such support. Secure plates in position by welding to studs or with bolts in expansion shields as appropriate.

Stair Nosings:

Form abrasive safety nosings for concrete stair treads and landings from FS-RR-T650, nonskid tread, three inches wide by eight inches less than the concrete width, with suitable approved anchoring devices. Provide bolted-on nonskid treads for all plain metal stair treads.

Gratings:

Provide gratings of the type and size indicated. Provide bearing bars not less than 1/8 inch thick. Provide structural supports for gratings, of the shapes indicated, fastened to the structure with anchors. Unless otherwise indicated, provide gratings which are removable but with locking legs and means of bolting in place.

Provide serrated edges on the top of the grating bars, or other means to provide non-skid surface. Provide solid perimeter banding.

Fabricate walkway grating by the electro-pressure welding method to form a sound welded joint at intersections of all bars, with the top surfaces of all bars in the same plane or in accordance with the manufacturer's standard practice.

Hatch Door for Vaults:

Provide steel vault doors reinforced for H2O loadings and hot-dipped galvanized, with zinc plated ferrous hardware.

Provide forged brass hinges with stainless steel pins, automatic hold open arms with stainless steel pins and vinyl grip and a stainless steel snap lock with removable outside handle, the socket of which shall be threaded and equipped with a non-ferrous plug.

Door shall be operable by a force not to exceed 30 pounds.

Connections:

Shop connections in weldable materials, not designed for service removable, shall be welded. All welding shall conform to AWS D1.1 requirements. Weld behind finished surfaces whenever possible. Grind all exposed welds smooth. Remove weld, brazing, and solder spatter, flux, slag and oxides from finished surfaces. Use sheet metal lock seams only when indicated on the Contract Drawings or approved shop and working drawings.

Complete all provisions for bolted field connections in the shop unless otherwise indicated.

Match exposed work to produce continuity of line and design. Fabricate and fasten metal work so that the work will not be distorted, the finish impaired, nor the fasteners overstressed from the expansion and contraction of the metal. Conceal fastenings whenever practicable. Use fastenings exposed to public view of the same color and appearance as the surrounding metal.

Castings and Forgings:

Fabricate castings and forgings as indicated. Casting and forgings shall be of uniform quality, true to pattern, strong, tough, of even grain, sound, smooth, without cold sheets, scabs, blisters and sand holes, cracks or other defects. Plugs, filled holes and welding will not be allowed. Castings shall be of thicknesses and configurations shown on the Standard Details. Sand blast as required to remove scale and sand and achieve a uniform smooth clean surface. Paint with asphaltum or coal tar paint meeting requirements of AWWA C203, where indicated. Provide raised letters where indicated.

Valve boxes shall be round head, sliding type consisting of snug fitting top, bottom section and sliding type extension. Lid shall be removable only by lifting straight up from the shaft shoulder.

Curb box assembly shall be Class 30, with bronze pentagon head screws having tensile strength at least 65,000 psi, yield strength at least 38,000 psi. Assembly shall be two piece buffalo-type with foot piece sized to accept proper size curb stop. Rods shall be of 9/10-inch hole rolled steel. Lids, screws, tops and extensions shall be standard size interchangeable with those of other manufacturers.

Meter yokes shall be Class 25, riser type to connect to vertical pipes with cut of valve on the water main side of the yoke, providing for expansion fitting on either side of yoke. Yoke shall be capable of holding the meter and pipe rigidly in place without strain on the piping. Brass inlet and outlet fittings shall meet requirements of ASTM B30, Class 4A. Inlet fittings shall have brass 90 degree cut off valve of inverted key-step type incorporated in the fitting. Outlet fitting

shall be 90 degree, with straight line between the inlet and outlet fittings. Provide rubber gasket so as to result in watertight expansion fittings. Provide fittings for copper inlets and outlets as required with gaskets, and manufacture the other end of fitting connections to take expanded copper connection or pipe-threaded connections, as appropriate.

Sewer manhole frames and covers shall have 1/4 inch flat neoprene gasket cemented to the inner cover so as to result in a watertight installation. Fit covers to frames by machining so as to produce no looseness or rocking. Cross bar and inner cover shall be cast iron with two handles integrally cast. Provide pentagon head locking bolt of bronze or stainless steel AISI Type 304, and nut with bronze husking solidly inserted at center of cross bar. Tap flange for four 3/4 inch anchor bolts spaced equidistant and centered around flange. 22-inch standard frame shall weigh at least 210 pounds, cover, at least 123 pounds. Lightweight frame shall weight at least 85 pounds, cover at least 73 pounds.

Lamp hole frames and covers shall meet requirements specified above for sewer manhole frames and covers except for weight criteria.

Storm drain manhole frames and covers shall meet requirements specified above for sewer manhole frames and covers with the following modifications: Do not provide neoprene gaskets with inlets. Round inlet frames shall weigh from 60 to 70 pounds covers from 80 to 90 pounds. Square frames shall weigh from 440 to 450 pounds, grates from 270 to 280 pounds.

Meter housing frames and covers shall meet requirements specified above for storm drain manhole frames and covers except for weight criteria.

Galvanizing:

Galvanize in accordance with reference standards set forth hereinbefore.

Items to be shop painted which are fabricated without welding entirely from, galvanized shapes, hardware and sheet shall not be galvanized after fabrication. All other fabrications to be galvanized shall be hot dipped after fabrication.

B. Erection and Installation

Erection work shall be in accordance with the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and the AISC Code of Standard Practice for Steel Buildings and Bridges, where applicable.

Upon completion of installations re-examine all work and provide additional shims, washers, anchors and corrective work as required to ensure that installation is firm, tight, anchored, in true alignment with neat fits, without distortions, unsightly fastenings, raw edges or protrusions.

4. Measurement and Payment

Measurement of miscellaneous metal work for payment will not be made under this Section. Miscellaneous metal work is considered supplemental material required in the construction of specific items of work that will be measured and paid for under various other items in the Bid Schedule.

DIVISION 7

THERMAL AND MOISTURE PROTECTION

| <u>SECTION NUMBER</u> | <u>TITLE</u> | <u>SHEET</u> |
|-----------------------|---|---------------------------|
| 07100 | ASPHALTIC WATERPROOFING AND DAMPPROOFING | 07100-1 To 07100-6 |
| 07500 | FLEXIBLE SHEET ROOFING | 07500-1 To 07500-6 |
| 07510 | BUILT-UP BITUMINOUS ROOFING | 07510-1 To 07510-8 |

SECTION 07100

ASPHALTIC WATERPROOFING AND DAMP-PROOFING

1. General

A. Description

This Section includes provisions of asphaltic membrane waterproofing and damp proofing as indicated in accordance with the Contract Documents.

B. Quality Assurance

Applicators shall be fully qualified and certified by the manufacturers of products being applied.

C. Submittals

Submit samples of the following items:

1. **Membrane, 12 inch by 12 inch**
2. **Adhesive, 1/2 pint**
3. **Tape, small roll**

Submit certified tests reports as specified before delivery of materials, for the items listed below:

1. **Bitumastic Primer**
2. **Bitumastic Coating**
3. **Membrane for Waterproofing**
4. **Asphalt and Primer for Waterproofing**

2. Materials

A. Dampproofing Materials

Dampproofing materials shall meet either of the following requirements at the option of the Contractor:

Type 1:

Prime coat for use with asphalt shall conform to requirement of FS-SS-A-701.

Asphalt shall conform to the requirements of FS-SS-A-666.

Type 2:

Creosote primer for use with coal-tar pitch shall conform to requirements of ASTM D450.

B. Membrane Waterproofing Material

Membrane waterproofing material shall meet the following requirements:

Asphalt shall conform to requirements of FS-SS-A-666, Type V.

Asphalt primer shall conform to requirements of FS-SS-A-701.

Asphalt saturated felt shall conform to requirements of FS-HH-R-595, Type II, 15 pound.

Plastic cement shall conform to requirements of FS-SS-C-153, Type I.

Waterproof building paper shall conform to requirements of ASTM C171, Regular.

3. Execution

A. Surface Preparation

General:

Do not start damp proofing and waterproofing until provisions for curing of the concrete have been complied with, and the surfaces have thoroughly dried.

Clean surfaces to be damp proofed of loose and foreign materials, concrete fins, and dirt.

Point-up holes, honeycomb, crack, and cavities or fill with Portland cement mortar and allow to cure completely before covering.

Additional Preparation for Membrane Waterproofing:

Provide one inch mastic cants in internal corners. Maintain surfaces thoroughly dry, immediately before and during the application of waterproofing, and thoroughly cleaned of all laitance, dust, dirt, projections, oil, grease, or other matter by brooming, scraping, airhosing, or by any combination thereof.

In areas where overhead drilling from scaffolds, bracing, or other construction is encountered, divert dripping clear of waterproofing areas.

B. Dampproofing Application

Apply dampproofing, consisting of two prime coats and one seal coat of dampproofing materials, to surfaces indicated to receive dampproofing.

Provide asphalt prime coat for use with asphalt dampproofing and creosote prime coat for use with coal-tar pitch dampproofing.

Brush paint or spray paint the surfaces to be dampproofed with two coats of primer. Allow the first coat to dry thoroughly before the second coat is applied.

Do not heat the prime coat material for application.

After the second prime coat has thoroughly dried, brush one coat of hot asphalt or coal-tar pitch as applicable over the primed surface at a rate of not less than 15 pounds for each 100 square feet of surface, filling cracks, voids and crevices.

Do not heat asphalt to a temperature in excess of 400 degrees Fahrenheit. Do not heat coal-tar pitch above 350 degrees Fahrenheit.

Apply dampproofing coat in a manner that will provide a continuous surface free of dull or porous spots. Give dull or porous spots an additional coating of hot asphalt or coal-tar pitch.

Perform finished work to conform to the dimensions shown and do not disfigure other areas or parts of the structure by dripping or spreading of the materials.

C. Built-Up Membrane Application

Heating of Asphalt:

Heat asphalt to flow freely, but not above 400 degrees Fahrenheit and stir frequently to avoid local overheating. Provide heating kettles of a quality, number and capacity to service the work adequately. Provide spare serviceable burners to be immediately available at the site for replacement of malfunctioning burners. Provide large metal pans at least one inch deep under kettle to prevent drippings or fuel leaks from falling on prepared concrete or membraned surfaces. Equip each kettle with a calibrated thermometer at all times.

Collect strippings from drums daily and remove from the site. Set up kettles immediately adjacent to the work in progress, to reduce the length of carry of hot buckets.

Lower hot asphalt from overhead with extreme care to avoid endangering workmen in trench or excavation.

General Procedures:

Mop surfaces to be membrane waterproofed in sections. Begin the waterproofing at the low point of the surface to the waterproofed. Allow sufficient fabric for suitable lap and anchorage at the upper edge of the surface to be waterproofed.

Cover the surfaces of concrete in contact with asphalt membrane waterproofing with one coat of asphaltic primer plied at the rate of not less than one gallon per 100 square feet before the first mopping of asphalt. Work the primer well into surfaces to give a uniform coating.

Apply the priming coat approximately 24 hours before the first mopping is applied.

Completely cover the concrete surfaces with the mopping so that no concrete is left exposed, and on fabric surfaces apply mopping sufficiently heavy to conceal the weave completely. For each mopping use not less than four and one-half gallons for each 100 square feet of surface.

Regulate the work so that at the close of the day all fabric which is laid will have received the final mopping of asphalt. Thoroughly seal all laps.

On the exterior of expansions and construction joints, lay a strip of waterproof building paper 12 inches wide; extend six inches on each side of the joint and secure to the surface near the edges, using an approved method, before the membrane is applied.

Do not permit one layer of fabric to touch another at any point, or touch the concrete surface; separate each by a mopped coat of hot asphalt.

At edges of membrane, insert membrane into reglets as indicated on the plans and caulk with an approved mixture of asphalt mastic and asbestos, an approved cement, or by using butyl gun tape and necessary boots to prevent water from getting between waterproofing and the surface to be waterproofed.

Protect penetrations in the membrane, such as pipes, conduits, plies, struts, walers, and other braces. Provide sleeves, clamping rings, or other approved devices at all penetrations and install with counter flashing where shown and mastic tape where needed to ensure a watertight joint.

Where pipes, sleeves for pipes, or drains, pass through surfaces to be waterproofed, provide synthetic membrane flashings and two additional plies of membrane extending at least one foot beyond the edge of flashing, set in place with hot moppings of asphalt and secure with galvanized iron clamps and bolts or by any other suitable approved method.

Two Ply Work:

For the first strip of fabric use half width; for the second use full width, lapped the full width of the first strip.

For each succeeding strip use full width and lapped so that there will be two layers of fabric at all points except at joints, which shall be lapped a minimum of two inches, this producing three piles at such overlaps.

Give the entire surface a final mopping of hot asphalt.

Three Ply Work:

Proceed the same as for two ply work, except that the first strip use 1/3 width; for the second strip use 2/3; and for the third and succeeding strips use full width and lap the strips at least two inches. Proceed so that the resulting surface will be completely covered by three plies, with four plies at overlaps.

More than Three Ply Work:

Build in single fashion similar to three ply work by the addition of as many plies as are shown. In joining membrane waterproofing to the waterproofing in place, clean and heat the in place waterproofing before joining the new waterproofing to that previously laid and lap such joints a minimum of one foot.

At intersections of walls with horizontal surfaces, and at other locations, lap the greater number of plies of membrane over the other plies a minimum of one foot.

Reinforce waterproofing at angles and expansion joints and at other location where the membrane may be subjected to unusual strain. Use reinforcing consisting of two additional plies of saturated fabric and alternate moppings of asphalt. At angles between floor and wall provide reinforcing strips of sufficient width to extend at least six inches on the floor and four inches up the wall. Extend strips vertical corners at least five inches on each side of the corner.

Patching:

Where the Engineer permits patching of defective built up waterproofing, extend the first patching ply at least 12 inches beyond the outermost edge of the defective portion.

Extend the second and each succeeding ply of the patch at least three inches beyond the preceding ply.

For patch area use at least as many new plies as specified for the original membrane.

Tightly fit waterproofing to the structure without voids or kinks. Upon completion, allow no cuts, holes, pockets, bulges, wrinkles, folds, or crease in the surfaces of the finished waterproofing. If such defects are present, repair by patching as specified. If the waterproofing is damaged, punctured, or in any way pervious and cannot be effectively patched or repaired, remove and replace to the extent necessary to satisfactorily waterproof the structure.

If any leaks occur in areas where backfilling has been placed, cut out the waterproofing where directed by the Engineer and patch as necessary, to ensure a watertight barrier.

D. Protect and Clean

Protect finished work during the application of waterproofing and dampproofing and repair damage.

Remove spots and spattering from finished work and leave the entire work area in first class condition.

4. Measurement and Payment

Measurement of dampproofing and waterproofing for payment will not be made under this Section. Such work is considered supplemental material required in the construction of specific items of work that will be measured and paid for under various other items in the Bid Schedule.

SECTION 07500

FLEXIBLE SHEET ROOFING

1. General

A. Description

This Section includes provisions for flexible sheet roofing systems as shown on the drawings and as specified herein.

B. Qualifications

The Contractor shall submit in writing to the Engineer, qualifications of manufacturers, installers, inspection and testing laboratories, indicating at least five years successful experience in flexible sheet roofing systems and materials.

Installer must be acceptable to the manufacturer or licensed by the manufacturer for installation of their systems.

C. Quality Assurance

Submit a certified statement from the manufacturer whose materials are being used, stating that materials used conform to the requirements of the Specifications and are appropriate for this Contract; are compatible with the deck indicated, each one to the other, and adjacent work; and that the installer is approved or licensed by the manufacturer.

Submit a list of three satisfactory roofing installations performed by the road installer using materials and methods similar to those specified herein.

D. Submittals

Submit specifications, installation instructions and general recommendations from manufacturer of flexible sheet roofing system materials.

Submit shop drawings in accordance with Section 01102 showing details of flashing at wall, drains, penetrations and typical locations where flashing is rewired to provide a watertight installation.

Submit samples in accordance with Section 01103 for each product specified. Each product shall be marked identified and permanently labeled with the name of the manufacturer and location intended for use along with ASTM or Federal Specification designation or other approved reference agency.

Submit roof plan showing layout of plumbing, electrical and mechanical work including locations and supports of various equipment.

E. Warranty

Provide written warranty, signed by the manufacturer of primary roofing materials and his authorized installer, agreeing to replace/repair defective materials and workmanship.

Warranty period is ten years after date of substantial completion.

F. Compatibility

Provide products which are recommended by manufacturers to be fully compatible with indicated substrates, or provide separation materials as required to eliminate contact between in-compatible materials.

G. Environmental Conditions

Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

2. Materials

A. Manufactures

Flexible sheet roofing products shall be manufactured by one of the following manufactures:

1. **J.P. Stevens & Co.**
2. **Carlisle Tire and Rubber Co.**
3. **Celotex Corp.**
4. **Firestone Ind. Products**
5. **Goodyear Tire and Rubber Co.**
6. **Manville Building Products**
7. **Gates Engineering**
8. **Dynamit Nobel of America**
9. **Or equal**

B. Elastomeric Sheet Material

Loose/ballasted system manufacturer's standard thickness but not less than 45 mils, 1400 psi minimum tensile strength (ASTM D 412), 250% elongation (ASTM D 412), vapor permeable, ultraviolet and ozone resistant, low temperature brittleness of -40 degrees Fahrenheit (ASTM D 746), standard color.

Mechanically fastened system-manufacturer's standard thickness but not less than 60 mils, 1600 psi minimum tensile strength (ASTM D 412), minimum tear resistance of 150 lbs per linear inch (ASTM D 624), 300% elongation (ASTM

412), ultraviolet and ozone resistant, low temperature brittleness of –40 degrees Fahrenheit/ Celsius (ASTM D 746), standard color.

C. Miscellaneous Materials

Aggregate surface ballast shall be washed, rounded riverbed gravel, granite, or other stone ranging in size from 3/4 “ to 1-1/2” in diameter, which will withstand weather exposure without significant deterioration, and acceptable to flexible sheet roofing manufacturer.

Mechanical fasteners – metal screws, nails, battens, accessory components, and adhesives as appropriate to substrate and as recommended by manufacturer of membrane material.

Adhesive shall be type recommended by manufacturer of flexible sheet membrane for particular substrate and project conditions, and formulated to withstand a minimum 60 psf uplift force.

Sheet seaming system shall be manufacturer’s standard materials for sealing lapped joints, including edge sealer to cover exposed spliced edges as recommended by manufacturer of flexible sheet roofing.

Cant strips and flashing accessories shall be types recommended by manufacturer of flexible sheet roofing, provided at locations indicated and at locations recommended by manufacturer, and including adhesive tapes, flashing cements, and sealants.

Slip sheet shall be type recommended by manufacturer for flexible sheet roofing for protection of sheet from in-compatible substrates.

D. Insulation

Roof insulation shall be one of the following types of insulation depending upon design of the roof, compatibility of materials and recommendation of flexible sheet roofing manufacturer. Provide appropriate thickness of material to meet “R” values shown.

1. Urethane Board Insulation (FS-HH-I-53-O, Type I, Grade 2, Class 1 or 2)
2. Extruded Polystyrene Board Insulation (FS-HH-I-524, Type IV, 1.1 perm-inch maximum vapor transmission; K value of 0.20 maximum; 20 psi compressive strength; 0.3% maximum water absorption).
3. Moulded Polystyrene Board Insulation (FS-HH-I-524, Type II, 15 psi compressive strength, 3% maximum water absorption; K value of 0.27 maximum).
4. Cellular Glass Board (FS-HH-I-551, Type I, with laminated Kraft paper faces, K value of 0.34)
5. Perlite Board (FS-HH-I-529, vapor permeable; K value of 0.36)

6. **Glass-Fiber Board Insulation (FS-HH-I-526; K value of 0.27)**

Adhesive for bonding insulation shall be the type recommended by the insulation manufacturer and complying with fire resistance requirements.

Mastic sealer for bonding edge joints and filling voids shall be as recommended by the insulation manufacturer.

Mechanical anchors shall be as recommended by the insulation manufacturer for deck type, and complying with fire and insurance rating requirements.

Vapor barrier shall be noncombustible FM class one construction and U.L. Construction No. 1 flexible sheet material held on roof decks with waterproof adhesive approved by NFPA or local agency having jurisdiction.

Walkway protection boards shall be prefabricated concrete powers containing no asphalt or coal-tar derivatives on shall be approved by the flexible sheet roofing manufacturer for use on the membrane.

3. Execution

A. Preparation

Comply with manufacturer's instructions for preparation of substrate to receive flexible sheet roofing system.

Commencement of roofing work will signify that all instructions for preparation have been followed.

B. Vapor Barrier

On steel decks, comply with U.L. requirements for "Roof Deck Constructions" which are rated "Fire Acceptable" and comply with FM requirements for "Class I" metal deck construction. Mop approved adhesive at the rate of 0.40 gallons per one hundred square feet of roof deck, which shall be in contact with vapor barrier. Lay vapor immediately so that bonding takes place. Lap each sheet of vapor barrier two inches over succeeding sheet. Lap ends six inches and seals all laps with adhesive.

C. Insulation

Extend insulation full thickness as a single layer over entire surface to be insulated. If two courses of insulation are specified stagger joints. Cut and fit tightly around all obstructions. Form cant strips, crickets, saddles and tapered areas with additional material as shown and as required for proper drainage of membrane. Comply will insulation and membrane manufacturer's recommendations.

Do not install more insulation each day than can be covered with membrane before end of day and before start of inclement weather.

D. Membrane

Meet all of the manufacturer's requirements for membrane installation and any additional requirements that are a condition for issuing warranty.

Cut sheets to maximum size possible, in order to minimize seams and to accommodate contours of roof deck and proper drainage across shingled laps of sheets.

Loose/ Ballasted Flexible Sheet Roofing:

Install membrane by unrolling over prepared substrate, nailing only at perimeter and at roofing penetrations. Lap adjoining sheets as recommended by membrane manufacturer and bond as recommended by manufacturer, covering top edges of each sheet at seams with uniform fillet of sealant. Install flashings and counterflashings as shown and as recommended by manufacturer. Apply ballast course in uniform thickness at the rate specified per square foot spreading with care to minimize possibility of damage to membrane.

Mechanically Fastened Flexible Sheet Roofing:

Install membrane by unrolling over prepared substrate, lapping adjoining sheets as recommended by the manufacturer and bonding and sealing seams. Install mechanical fasteners at spacing recommended by manufacturer, covering with adhesive applied membrane so that no fasteners are exposed. Install flashings and counterflashings as shown or recommended by the manufacturer.

Adhesive Adhered Flexible Sheet Roofing:

Install membrane by unrolling over prepared substrate, lapping adjoining sheets as recommended by the manufacturer. Apply adhesive to surfaces to be bonded and roll flexible sheet roofing into place when adhesive has properly cured. Treat seams with special cement and apply sealant to exposed sheet edges, tapering application as recommended by the manufacturer. Install mechanical fasteners, flashings and counterflashings, and accessories at locations and as recommended by the manufacturer.

If specified for neoprene sheet, apply two coats of "Hypalon" color coat as manufactured by E.I. DuPont within thirty days of sheet insulation, in accordance with manufacturer's instruction. Apply each coat at the rate of 100 square feet per gallon.

E. Walkway Protection Boards

Install board at locations shown and where required for access to roof-mounted equipment. Place protection boards carefully to avoid damage to membrane, laying over an additional layer of roof membrane material, loosely applied, for additional protection.

4. Measurement and Payment

Flexible sheet roofing systems will be paid for lump sum at the bid price for the complete system in place.

SECTION 07510

BUILT-UP BITUMINOUS ROOFING

1. General

A. Description

This Section includes provisions of built-up roofing as shown on the drawings and as specified herein.

B. Qualifications

Contractor shall submit in writing to the Engineer, qualifications of manufacturers, applicators and inspection and testing laboratories, indicating that each has been actively engaged in above mentioned business operations for a period of at least five years.

C. Quality Assurance

Before starting any part of roofing work submit a certified statement from the manufacturer whose materials are used, stating that materials used conform to the requirements of the Specifications and are appropriate for this Contract; are compatible with the deck indicated, each one to the other, and adjacent work; and that the roofing applicator is approved by the manufacturer.

Submit a list of three satisfactory roofing installations performed by the roof applicator using materials and methods similar to those specified herein.

D. Submittals

Submit shop drawings in accordance with Section 01102 showing details of flashing at wall, drains, penetrations and typical locations where flashing is required to provide a watertight installation.

Submit manufacturers printed specifications of material and methods of application for the type roofing system required for the project as shown on the drawings.

Submit samples in accordance with Section 01103 for each product specified. Each product shall be marked identified and permanently labeled with the name of the manufacturer and location intended for use along with ASTM or federal specification designation or other approved reference agency.

Submit roof plan showing layout of plumbing, electrical and mechanical work including locations and supports of various equipment.

E. Warranty

The Contractor shall guarantee the entire built-up roofing system including flashing to be free of leaks and defects due to improper materials and workmanship for a period of two years from the date of final acceptance under this Contract.

Provide certified statement from the manufacturer that he has examined the contract documents and that his product will perform without leaks and defects for ten years. Three copies of the certified statement shall be submitted to the City before final payment is made.

F. Test Cuts

Cut and submit for inspection, a sample of roof construction, if so desired by the Engineer. The size of the sample shall be approximately four inches by 42 inches cut at right angles to the length of felts. Patch the freshly cut area immediately upon removal of test sample with same material and techniques employed in constructing the original roofing membrane. Allowable weight tolerance for such test cut samples shall not be more than 15 percent plus or minus.

G. Delivery and Storage

Materials shall be delivered in unopened original factory containers and shall be stored in an approved storage area.

H. Environmental Conditions

Work shall be performed under temperature and climatic conditions recommended by manufacturer.

Built-in roofing work shall not be performed with temperature under 40 degrees Fahrenheit. Protect the work during installation and upon completion until acceptance.

2. Materials

A. Manufacturer

The product furnished shall be manufactured by one of the following manufacturers:

1. **Celotex Corporation**
2. **Johns-Manville**
3. **GAF**
4. **Or equal**

B. Various materials involved in the work shall meet the following requirements:

1. **Asphalt primer for priming concrete and masonry shall conform to requirements of ASTM D41-70.**
2. **High melting point (steep) asphalt for mopping shall conform to requirements of ASTM D312-71 III or D449-71 Type C.**
3. **Low melting point (dead level) asphalt for mopping with self-healing property shall conform to requirements of ASTM D312-71, Type 1.**
4. **Coal tar pitch shall conform to ASTM D450, Type A.**
5. **Asphalt saturated organic felt shall conform to requirements of ASTM D226, 15 pounds.**
6. **Asphalt saturated asbestos felt, saturated with refined asphalt shall conform to requirement of ASTM D250.**
7. **Asphalt saturated heavier gauge felt shall conform to requirements of ASTM D226-68.**
8. **Asphalt impregnated glass fiber felt shall conform to requirements of ASTM D2178.**
9. **Asphalt saturated felt with mineral granules shall conform to requirements of ASTM D249.**
10. **Coal tar saturated felt shall conform to requirements of ASTM D227.**
11. **Smooth surfaced roofing shall conform to requirements of ASTM D224, 55 pound grade.**
12. **Mineral surfaced roofing shall conform to requirements of ASTM D1863.**
13. **Aggregate for surfacing shall conform to ASTM D1863.**
14. **Built-in base flashing shall be in accordance with requirements of manufacturer.**

Bituminous plastic cement shall conform to requirements of F.S. SS-C-153, Type 1 or 2 as required.

Asphalt saturated and coated asbestos felt shall conform to requirements of ASTM D655.

Cant: Treated fiberboard, wood and asbestos roof cant strips and edge strips shall conform to requirements of F.S. LLL-1-535A, Class C.

Vapor barrier shall be noncombustible FM class one construction and U.L. Construction No. 1 flexible sheet material held on roof decks with waterproof adhesive approved by NFPA or local agency having jurisdiction.

Nails for fastening roof insulation to steel deck shall be black oxide coated having minimum holding power of 262 pounds per nail. The fasteners shall have passed Factory Mutual Class I wind uplift resistance test.

Roof insulation shall be one of the following types of insulation depending upon design of the roof, roofing material and slope or as indicated. The insulation value of the roofing system shall not be less than R=30.

Batt Insulation

Rigid Insulation

Poured Gypsum Insulation

Or as indicated

Fasteners and adhesives shall be of type recommended by manufacturer of roofing felts and insulation and shall be type approved by NFPA or local agency having jurisdiction.

3. Execution

A. Preparation

Surface Condition:

Before starting work, verify that the surface to receive roofing is clean, smooth without visual potholes and ponds.

Report any condition which cannot achieve desired results.

Do not begin roofing work if the slope of roof surface is found to be less than one quarter inch in one foot.

Remove all traces of snow, ice, frozen scale, grease and surface water. Sweep clean any debris, foreign and loose material or dust on the roof. Verify that roof surface is dry. If required by the Engineer, test roofing surfaces for dryness and adhesion.

Bring to proper grade any low lying area with filler material, as recommended by roofing system manufacturer, seal cracks and make good any defects on any of the roof surface. Cover and treat expansion joints with appropriate covers.

Do not allow any pipes, conduits or wires on the roof, unless mounted on adjacent vertical surfaces or walls. In absence of vertical surfaces conduits, wires and equipment shall be mounted or supported on framing constructed for the purpose at least 18 inches above the roof. Do not leave loose wires and pieces of conduits on the roof upon completion of respective trades. The

construction of supporting frames shall be carried out according to details shown on drawings or as approved by the Engineer.

Commencement of roofing work shall signify that Contractor has accepted the existing condition and that he is satisfied with the condition of the surface.

B. Roofing Specifications

Roofing specifications described herein are based on a 10-year rated built-up roofing system over 18 to 22 gauge metal deck with a roof slope of not less than quarter inch in one foot and not more than half-inch in one foot together with following materials on top:

1. Vapor Barrier
2. Rigid Insulation
3. Asphalt Saturated Felt
4. Aggregate Surfacing

C. Vapor Barrier

Apply asphalt or coal tar for mopping or other appropriate type of adhesive at the rate of 0.25 to 0.40 gallons per one hundred square feet of roof deck which shall be in contact with vinyl vapor barrier. Lay vapor barrier immediately so that proper bonding takes place.

Lap each sheet of vapor barrier two inches over succeeding sheet. Lap ends six inches and seal all laps with adhesive.

D. Insulation

Apply same adhesive used for vapor barrier on top of vapor barrier already in position.

Use 0.40 to 0.70 gallons of adhesive in ribbons per one hundred square feet of roof area and embed insulation while wet.

Do not install insulation if one of the following conditions exist:

Roof deck is not completely dry.

Traffic by crew and equipment of other trades may permanently injure insulation.

Lay insulation in parallel courses with staggered end joints in adjoining courses. Stagger joints in each layer from the joints in those of below. Butt each panel tightly to adjoining panels and discard all damaged panels.

Fasten roof insulation on steel roof deck with nails as specified hereinbefore, driven by pneumatic gun with 85 pounds of air pressure.

Provide temporary water cut-off for insulation at the end of days work, where the work of insulation is to resume next day. The water cut-off shall be in the form of two plies of tarred felt and mopping of pitch extending six inches on roof deck and six inches on insulation.

Remove completely cut-off assembly and clean affected surfaces on resumption of the insulation work next day.

E. Built-Up Roofing Quantities

Built-up roofing shall consist of following minimum quantities over insulation for each one hundred square feet of roof area:

- | | |
|--|-------------|
| 1. Asphalt Primer | one gallon |
| 2. Steep Asphalt | 23 pounds |
| 3. Coated Base Sheet | one ply |
| 4. No. 15 Asphalt-Asbestos Felt (Perforated) | three plies |
| 5. Dead Level Asphalt | 69 pounds |
| 6. Top Coating | 60 pounds |
| 7. Surfacing Gravel | 500 pounds |

Where coal tar is used, provide same quantities as listed above.

F. Application (Asphalt is described; substitute “coal tar” as applicable)

Maximum heated temperature of dead level asphalt shall not be more than 400 degrees Fahrenheit and shall be as much as possible above 300 degrees Fahrenheit at the time of actual application.

Solid mop steep asphalt on insulation already secured to steel roof deck and while hot, embed one ply of coated base sheet into the mopping. Lap each sheet four inches over underlying sheet. Lap ends of the coated base sheet six inches. Seal all laps with hot asphalt. Broom each ply to assure complete embedment.

Over entire surface of base sheet, starting at low point of roof, mop a uniform coating of steep asphalt. Mopping shall be uniform for the entire weight of the applied asphalt.

Embed in mopping of steep asphalt, while hot, three plies of No. 15 asphalt asbestos perforated felt. Starting at low point use starter strips of felt 12 inches and 24 inches wide followed by full width of felt sheets. Do not let layer of felt touch layer of felt below. Lap each ply of felt 24-2/3 inches over preceding ply. Mop full width of sheet with continuous coating of asphalt approximately 23 pounds per 100 square feet. Mop solidly over each ply, so

that succeeding ply is thoroughly embedded in the preceding mopping of asphalt.

Pour over entire surface of the roofing membrane a uniform flood coating of dead level asphalt as top coating into which, while hot, embed not less than 500 pounds of 3/8 inch to 1/2 inch gravel per one hundred square feet of roof area.

G. Roof Walkways

Provide built-up roof walkways as described below and as shown on the drawings.

Install walkway sheets consisting of a monogeneous core of asphalt and plasticizers bonded by heat and pressure between two coated felts in size of 3/4 inch by 36 inches by 36 inches.

Mop roof area to receive walkway sheets with hot asphalt or adhesive before applying gravel to the roof. Lay walkway sheets at six inch intervals around equipment, motors, air handling units and in straight lines from roof hatch to all equipment.

H. Base Flashing

Provide base flashing at all vertical surfaces, parapets, walls, curbs and penetrations through roof. Apply base flashings in accordance with details shown on drawings and as specified herein.

Extend all plies of roofing felts and asphalt moppings on to all vertical surfaces including walls, parapets, and penetrations like equipment supports through roof at least four inches above the top edge of cant strip.

Provide a reglet in vertical walls not more than twelve inches above roof deck.

Prime vertical surfaces from top of roofing felts to the reglet or immediately below the point where metal cap flashing enter the wall with asphalt primer and dry thoroughly.

Apply elastomeric flashing adhesive at the rate of one gallon per 100 square feet on the roofing, from a distance of three inches out from the base of cant to the underside of metal cap flashing. Apply a medium film with brush roller or squeegee.

Apply adhesive on approximately 20 or 30 feet of wall and dry partially.

Apply flashing sheet with dry adhesive on backside in required widths and length of approximately six to ten feet. Butt end joints.

Apply flashing to adhesive and rub entire sheet to remove trapped air bubbles beneath it, while carefully butting the ends of sheets.

At corners, cut flashing about four inches larger and overlap ends with adequate adhesive between them.

Apply in accordance with manufacturer's instructions four-inch tape at butt joints from flashing top to the termination point of the roof.

Nail flashing sheets through one-inch diameter metal caps, one inch below top edge of flashing on twelve-inch centers. Coat nails and caps with lap adhesive.

Install metal cap flashing overlapping base flashing a minimum of four inches.

4. Measurement and Payment

Built-up bituminous roofing will be paid for lump sum at the bid price for the roofing complete in place.

DIVISION 16

ELECTRICAL

SECTION NUMBER

TITLE

SHEET

16050

**GENERAL ELECTRICAL
WORK**

16050-1 To 16050-3

16500

**ELECTRICAL SYSTEMS
(STREET LIGHTING AND
TRAFFIC SIGNALIZATION)**

16500-1 To 16500-15

SECTION 16050

GENERAL ELECTRICAL WORK

1. General

A. Description

This work shall include furnishing, installing and testing for all electrical items referred to in this Section.

2. Permits and Licenses

The Electrical Contractor must hold a valid Frederick City Electrical License. The Electrical Contractor shall submit to the City of Frederick Department of Permits and Code Management a copy of their current, valid license before any work can be performed on City owned projects. The Department of Permits and Code Management and/or Department of Public Works shall perform all electrical inspections required for the electrical portion of their contract. The Electrical Contractor shall apply for any pay all fee for permits, inspections and licenses. The Electrical Contractor shall pay all power company electrical costs involved in supplying services to City owned projects.

3. Materials

Materials shall comply when applicable to the Underwriter's Laboratories requirements and meet the applicable minimum standards. The materials shall also comply with the National Electrical Code and local codes for the area of installation.

All materials and equipment installed as part of the permanent installation shall be new. Insofar as practical, all major items of electrical materials and equipment, such as lamps and luminaries, different parts of lighting standards, etc. shall be produced by the same manufacturer.

The Contractor shall submit to the Engineer for approval, all necessary documents such as detail plans, drawings, photographs, photometric data, schematics, templates and specifications of all apparatus and equipment he proposes to furnish. The shall show clearly the design, construction, dimensions, quantities and any other information as may be necessary or desirable for a proper understanding of the equipment offered. All material sheets, curves, etc., defining the above shall identify the specific project to which the material applies; and if more than one catalog number, style or type is listed on one sheet, the item to be furnished shall be clearly marked.

The Contractor shall not order electrical material until written approval of the submission is received from the Engineer. Approval by the Engineer will not relieve the Contractor of responsibility for erroneous or inconsistent dimensions,

notations, omissions or other errors or the proper functioning of the complete installation.

4. Construction Requirements and Licenses

All installations shall be in accordance with the National Electrical Safety Code, State and local laws and ordinances governing the work, and with the rules and regulations of the electrical utility serving the facility.

The Electrical Contractor shall notify the Department of Permits and Code Management for inspection of service equipment prior to the installation of any meters.

The Contractor shall be responsible for furnishing all personnel and equipment required to successfully perform the following tests and shall furnish six certified copies of complete tests reports to the Engineer.

Not less than 30 days prior to the commencement of each required test, the Contractor shall submit to the Engineer the types, styles, or catalog numbers of all testing equipment to be used for the tests. A written certification shall be included, stating that the testing equipment was last calibrated by an approved testing agency not more than 60 days prior to the date when the tests are to be performed. All tests are to be performed in the presence of the Engineer. The Contractor shall provide 72 hours notice prior to testing.

5. Testing

A. Conductivity Testing

The ground conductivity test shall use a megger ground tester of the hand crank type. The test method to be used shall be Fall of Potential Method. No corrected reading greater than 25 ohms will be accepted. The Contractor shall submit in writing to the Engineer a list of readings itemized and identified for all units as given above.

The Contractor shall test cable installed and shall demonstrate to the satisfaction of the Engineer that all conductors are continuous and free from short circuits and unspecified grounds and that all circuits are properly connected in accordance with the Plans.

Any defects found in the completed installation, in materials, specified equipment performance and/or workmanship, as a result of these tests, shall be repaired and/or replaced promptly without any additional cost to the City.

B. Circuit Testing

A circuit test to determine the insulation resistance shall be measured for each insulated cable, except pole and bracket cable, in all feeders and all distribution circuits, including duct cable used in distribution circuits. The test shall be performed on each cable of each circuit with all ballasts and transformers disconnected and all connections to earth grounds, including

ground rods and grounding connections to light poles disconnected. Units of measurement for reporting shall be expressed in megohms. The cable insulation resistance shall exceed 10 megohms.

C. Performance Testing

A performance test shall be conducted prior to acceptance. The Contractor shall operate the lighting system, including automatic control equipment and other specified apparatus, from sunset to sunrise for 30 consecutive days without interruption or failure. If a lamp or the ballast should fail, it shall be immediately replaced. This shall not require a restart of the test. The Contractor shall record each fault, the method and date of correction of each, and the beginning and ending of the 30 day test period. If 5 percent of any system components under test fail, then the 30 day test period shall commence again for the entire system.

If the performance test is conducted prior to all other tests, the Contractor shall energize and manually operate the entire lighting system, including control equipment for a minimum period of one hour to insure that all connections were restored after testing.

D. Illumination Testing

An illumination test shall be conducted by the Contractor to determine the illumination characteristics of the lighting installation by measuring foot-candles at locations designated by the Engineer, in accordance with IES testing procedures.

Costs for power necessary to conduct tests will be borne by the City.

6. Method of Measurement and Payment

The work described in this Section will not be measured for payment. All costs of materials, labor, equipment and incidentals required for performing the tests shall be included in the Contract unit prices for the respective items.

SECTION 16500
ELECTRICAL SYSTEMS
(STREET LIGHTING AND TRAFFIC
SIGNALIZATION)

1. General

A. Description

This section includes all work necessary for the installation of street lighting and traffic signalization systems, complete in place to the limits indicated on the Contract Drawings.

B. Requirements

All materials and equipment to be used in new systems or modifications to existing systems of street lighting and/or traffic signalization shall meet the requirements specified in Section 16050 and shall comply with UL, NEMA, NEC and local codes when applicable.

The Contractor shall notify the electric utility company supplying the project area prior to the start of work.

The Contractor shall notify the City Engineer and Director of Public Works, as applicable, to the project forty eight (48) hours prior to start of work.

Any traffic control items not specifically covered in the Contract Documents shall meet the requirements of the Manual on Uniform Traffic Control Devices. When existing street lighting systems or traffic signalization systems are abandoned as part of the work, all existing above ground lighting and signal equipment shall be salvaged and returned to the City in the same condition that it existed prior to start of work. The equipment shall be returned complete including all related hardware. All in ground concrete bases shall be removed and disposed of. In some cases of deep bases, they shall be cut 12 inches below grade, filled in with suitable soil and seeded.

C. Quality Assurance

All materials and equipment shall be inspected, tested and/or checked for certification and accepted by the Engineer before being incorporated into the work.

The Contractor shall furnish all labor, material and instruments as required to perform applicable tests as specified in Section 16050.

For traffic signalization systems, the Contractor shall coordinate with the City Traffic Division a schedule for delivery of all traffic control devices to this Division for testing. The test shall consist of a complete system hook up to be

done by the equipment manufacturer's representative. Demonstration of seven (7) consecutive days satisfactory performance of the system is required before incorporating the equipment into the work. Before final acceptance of the completed work, the City of Frederick will test the signal system for a period of thirty (30) days. If, during this period a problem arises, it shall be resolved at the Contractor's expense and a new thirty (3) day test period shall begin.

The Contractor shall protect all accepted material and equipment from damage and mishandling until final acceptance of the work. Material and equipment found to be defective will be rejected by the Engineer and shall be removed and replaced by the Contractor at his expense.

2. Materials and Equipment

A. Street lighting

Poles and fixtures for street lighting shall conform to the models and manufactures specified in the Standard Details.

Fixtures for commercial and entrance lighting shall conform to the models and manufactures specified in the Standard Details. Poles shall conform to the dimensions shown in the Standard Details. Streetlight poles shall conform to ASTM Designation A-572 or ASTM A-595.

Metallic conduits and fittings shall meet the requirements of Federal Specification W-C-581.

Nonmetallic conduit and fittings shall meet the requirements of Federal Specification W-C-581 to ASTM D-1785 and shall be PVC, Schedule 40.

Driven conduit shall be galvanized pipe meeting the requirements of ASTM A-120, Schedule 80.

Electrical Cables

All cables shall meet the requirements of the IPCEA Standards Publication S-19-81 and S-66-524. Conductors shall be in accordance with Part 2 of IPCEA Standard S-19-81 or S-61-42. Copper conductors shall be soft drawn or annealed copper, tinned or lead coated, meeting the requirements of ASTM Specification B-8, Class B Stranding.

Cable in conduit for circuits operating at 600 volts or less shall be of the sizes specified. The cable shall be single conductor, stranded copper having an unshielded, chemically cross-lined thermosetting polyethylene 600 volt insulation. The cable shall be suitable for installation in conduit and shall meet the requirements of Underwriter's Laboratories USE, XHHW, or THWN/THHN.

Cable for installation in lighting shafts, bracket arms and to luminaries shall be 600 volt type SEO Polar/Solar multiconductor portable cord 105 degrees U.L. listed per ASTM B-174. Ampacity based on 105 degrees rating per ICEA P-46-426 formulation 30 degrees Celsius ambient. Conductor size shall be 14/3 copper stranded.

Ground conductors shall be stranded bare copper meeting the requirements of ASTM B-3 and B-8. The ground wire shall be a single conductor, soft drawn of the size specified.

Reinforced concrete handholes and electrical handhole box frame and cover shall be of materials indicated in the Standard Details. Handhole frame shall have means to attach a ground lug.

Electrical junction box frames and covers shall be fabricated of steel conforming to AISC-1020 as indicated in the Standard Details. Frame is to be fitted with a ground lug.

Ground rods shall be copper clad steel with painted end and shall be a minimum 3/4 inch diameter and 10 foot length unless otherwise noted on the plans or Standard Details.

Control and distribution equipment shall conform to the model and manufacturer indicated in the Standard Details unless otherwise indicated on the plans and approved by the Engineer.

B. Traffic Signalization

All traffic signal heads, pedestrian signal heads and lamps shall meet the requirements of the latest Institute of Traffic Engineers (ITE) specifications and standards. Housings shall be die-cast aluminum alloy with stainless steel hardware.

Optically Programmed Signals

Optically programmed signals shall have the optical system comprised of the lamp, lamp collar, optical limiter-diffuser, objective lens and color filter.

The lamp shall meet the requirements of the latest ITE specifications and standards. The lamp shall be coupled to the diffusing element with exception of a collar including a specular inner surface. The diffusing element may be discrete or integral with the convex surface of the optical limiter.

The optical limiter shall provide an accessible imaging surface at focus on the optical axis for objects 900 to 1200 feet (270 to 370 m) distance and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be composed of heat resistant glass.

The objective lens shall be a high resolution planar incremental lens hermetically sealed within a flat laminate of weather resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90 degree orientation about its axis without displacing the primary image.

The optical system shall accommodate projection from a single section of diverse, selected indicators to separate portions of the roadway such that only one indication will be simultaneously apparent to any viewer. The projected indications shall meet the requirements of ITE chromaticity standards.

Die cast aluminum parts shall meet the requirements of ITE alloy and tensile requirements and have a chromate preparatory treatment. The exterior of the

signal case, lamp housing and mounting flanges shall be finished with prime baked enamel finish paint. The lens holder and interior of the case shall be optical flat black.

Signal cases and lens holders shall be pre-drilled for backplate and visors. Hinge and latch pins shall be stainless steel. All access openings shall be sealed with weather resistant rubber gaskets.

Sheet metal parts, including visors and backplates, shall meet the ITE material requirements and include a chromate preparatory treatment and optical black on all surfaces.

Attachments such as visors, backplates or adapters shall readily fasten to existing mounting surfaces without affecting water and light integrity of the signal.

Lamp fixtures shall comprise a separately accessible housing and integral lamp support, indexed ceramic socket and self-aligning, quick release lamp retainer. Electrical connection between case and lamp housing shall be accomplished with an interlock assembly which disconnects the lamp holder when opened. Each signal section shall include a covered terminal lock for clip or screw attachment of lead wires. Concealed No. 18 AWG Stranded and coded wires shall interconnect all sections to permit field connection within any section.

Each signal section shall include integral means for regulating its intensity between limits as a function of individual background illumination. Lamp intensity shall not be less than 97 percent of uncontrolled intensity at 1000 fc (10.8 klx) and shall reduce to 15 plus or minus 2 percent of maximum at less than 1 fc (11 lx). Response shall be proportional and essentially instantaneous to any detectable increase of illumination from darkness to 1000 fc (10.8 klx) and damped for any decrease from 1000 fc (10.8 klx).

The intensity controller shall comprise an integrated, directional light sensing and regulating device interposed between lamp and line wires. It shall be compatible with 60 hertz input and responsive with the range 105 to 135 volts. Output may be phase controlled, but the device shall provide a nominal terminal impedance of 1200 ohms open circuit and a corresponding holding current.

Traffic signal electrical cable shall meet the requirements of the International Municipal Signal Association (IMSA) Specification No. 19-1. Cable shall consist of seven stranded copper conductor No. 14 AWG unless otherwise noted on the plans and shall have the appropriate number of wires as indicated on the wiring diagram. All conductors shall be color coded in accordance with IMSA Specification No. 19-1, Table 2.

Service cable used to provide electrical service to the traffic signal controller shall be 3 conductor No. 3/0 or No. 2 AWG copper stranded cable, 600 volt, with a PVC jacket of not less than 0.063 in. (1.60 mm) and shall meet the requirements of Underwriter's Laboratories Type THWN or THHN Cables are to be colored black, red and white.

Loop detector lead in cable shall be IMSA Specification No. 50-2, 1984 of latest edition. This specification covers paired polyethylene insulate. Polyethylene jacketed loop detector lead in cable, rated 600 volts. The conductors shall be stranded fully annealed tinned copper and shall conform to the requirements of ASTM Designation B-33, latest version. The conductors shall be No. 14 gauge stranded. The conductors may be either concentric or bunch stranding and conform to ASTM Designation B-8, latest revision for concentric stranding or ASTM Designation B-174, latest revision for bunch stranding. The insulation shall meet ASTM Designation D-1248-B, latest revision, Type 1, Class B, Grade 4. The conductor color code shall be one natural (clear) and one black. The insulated conductors shall be twisted into a pair with a maximum length of lay of 4.0 inches. The conductor assembly shall be completely covered with a spirally wrapped alum mylar tape with the alum side out. A stranded tinned copper drain wire shall lay in the core interstice outside the core tape against the alum side of the core and shall be two gauge sizes less than the conductor gauge.

The jacketing material shall meet the requirements of ASTM Designation D-1248, Type 1, Class C, Grade 5, J-3, latest revision.

Loop wire cable is to be used within a roadway saw cut to form an area of detection. The loop wire cable shall be single conductor No. 14 AWG 19 stranded with a nylon jacket of not less than 0.004 in. (0.10 mm) and shall meet the requirements of Underwriter's Laboratories Type THHN.

Loop detector amplifiers, sensor units and control units shall meet the requirements of NEMA. The Contractor shall provide certification that all material specifications have been met and the manufacturer must provide a minimum two year warranty on all equipment and materials.

Signal hand boxes, frames and covers shall be the same as specified for electrical junction boxes.

Push-button assemblies for pedestrian crossings shall be constructed of heavy cast aluminum. All mounting hardware shall be corrosion resistant material. All exposed screws shall be tamper proof, stainless steel or other rust resistant materials as approved by the Engineer.

Signal poles and mast arms shall be as detailed on the Plans. Steel pole shafts and arms shall meet the requirements of ASTM A-595 or ASTM A-572, galvanized to meet the requirements of ASTM A-123. Bolts and nuts for flange plates shall be high strength steel meeting the requirements of ASTM A-325. Anchor bolts, locking and leveling nuts shall be as specified in Foundations.

Strain poles shall be as detailed on the Plans. Pole shafts shall be hot-rolled 0 gage steel meeting the requirements specified for signal poles. Screws, nuts, bolts and washers shall be stainless steel, Type 304. Anchor bolts, locking and leveling nuts shall be as specified in Foundations.

Pedestrian poles shall be as indicated in the Standard Details. Steel for poles shall meet the requirements of ASTM A-572 or ASTM A-595. Screws, nuts, bolts and washers shall be stainless steel Type 304. Transformer base shall be case aluminum alloy meeting the requirements of ASTM B-26, Alloy 356.0 and

the FHWA requirements. Anchor bolts, locking and leveling nuts shall be as specified in Foundations.

Span wire shall be 3/8 inch (10mm) in diameter unless otherwise specified. Span wire shall be fabricated of seven steel wires, Class A galvanized meeting the requirements of ASTM A-475, and twisted into a single concentric strand meeting the strength requirements shown on the Plans.

Steel messenger rings of 1-1/2 to 3 inch (40 to 75mm) shall be mechanically or hot-dip galvanized after fabrication. The coating shall meet the quality requirements of ASTM A-153.

Traffic signal electrical conduit shall be as specified for street lighting.

C. Foundations

Concrete foundations shall be constructed to the dimensions shown on the Plans or Standard Details. Concrete for foundations shall be MSHA Mix No. 2 concrete. Reinforcing steel shall consist of deformed bars meeting the requirements of ASSHTO M-31, Grade 40 or 60. Conduits shall be as specified in Street Lighting. Anchor bolts, nuts and washers shall be high strength steel having a minimum yield strength of 55,000 psi with the differential between yield strength and ultimate tensile strength a minimum of 15,000 psi. Bolts, nuts and washers shall meet the requirements of ASTM A-325 and shall be galvanized meeting the requirements of ASTM A-153.

D. Paint

Paint shall be as specified in the Standard Details or as approved by the Engineer.

3. Execution

A. Street Lighting

Lighting standards shall be installed at the locations shown on the plans and be in accordance with the Standard Details. Pole shafts must be plumb after erection. Finish of all exposed surfaces shall be as specified in the Standard Details or as directed by the Engineer. Branch circuit wiring for street lighting shall have a separate circuit for each side of street.

Conduit for street lighting shall meet all requirements of UL for material and workmanship as well as all local codes. Conduits shall be of the sizes shown on the plans but never be less than 1-1/4 inches in diameter. Alignment of conduit shall be approved by the Engineer prior to installation. Depth of conduit shall be 24 inches from finished grade to top of conduit unless otherwise indicated on the drawings or directed by the Engineer. Roadway crossings shall be 30 inches.

Trenches for underground electric service shall be excavated to the line and dimensions specified on the Plans and standard details.

Backfill shall be placed in 8 inch loose layers, compacted and stabilized with seed or paving to its original condition.

Metallic Conduit

Conduit runs shall be made with as few couplings as standard lengths will permit. Screw couplings shall be used. All cut ends shall be reamed.

Conduits shall have threaded ends coated with an approved material and be of sufficient length so that they will butt squarely and tightly in the coupling. Long running threads will not be permitted. Conduits shall be installed so as to be continuous and watertight between boxes and/or equipment. All conduits ending in panels, junction boxes, or handholes shall have a bushing to protect the cable from abrasion.

Nonmetallic Conduit

Plastic (PVC) conduits shall be cut with a saw and all ends shall be accurately tapered or other side finished depending on the type of conduit and coupling specified. Tools recommended for this work by the conduit manufacturer shall be used, and finished ends shall be equal to those supplied by the manufacturer. All ends shall be smoothed of burrs or fins. Standard bends shall be used wherever possible, and special bends shall preferably have a radius not less than that of standard bends.

All joints shall be sealed with a waterproof joint sealing compound recommended by the conduit manufacturer and approved by the Engineer. All joints thus treated must be waterproof.

Bends shall be of long seep, free from kinks and of such easy curvature as to permit the drawing in of conductors without damage to the conductors. The radius of curvature of inner edge of bends shall not be less than 10 times the inside diameter of the conduit, except as may be otherwise noted on the Plans or in the Special Provisions. Conduits shall not be flattened or distorted. The total angle of all bends between any two boxes or fittings shall not exceed two quarter bends.

During construction, all ends of conduits shall be capped by use of standard pipe cap or equal to prevent introduction of foreign material into conduit. All open ends of conduit provided for future use shall also be capped and marked with a 3/4 inch metallic rod to grade.

After installation, all conduit which will not have circuit wire or cable pulled into it during construction shall have a No. 10 AWG copper clad or aluminum clad pull wire installed in it. The ends shall be closed with capped bushings or otherwise sealed in an approved manner to completely keep all moisture and foreign matter out of the conduit.

Immediately prior to the installation of conductors in any run, each conduit run and fittings shall be swabbed clean with a pull-through type device.

All conduit ending in a junction box, service panel, light pole base, or hand hole shall be fitted with a bushing to protect the cable from abrasion.

Conduit to be placed under existing pavements or paved shoulders may be installed by horizontal augering or jacking methods subject to the approval of the Engineer. The contractor must receive written approval from the Engineer prior to the commencement of work for other thrust boring methods.

The ducts for installation in augered holes shall be placed in a hole augered under the pavement between the handboxes. The duct shall be installed by pushing in sections and coupling them together as the work progresses. The advance end of the first section of rigid duct shall be capped before pushing it into the augered hole.

The ducts for installation by jacking shall be installed by thrusting sections under the pavement with a hydraulic ram. Sections of rigid duct shall have a pointed nose cap screwed onto the advance end to facilitate penetration.

The Contractor shall avoid disturbing the existing roadway surface or weakening the roadbed. Any damage to the existing pavement structure shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

The Contractor shall furnish and install copper conductor wire and cable of the types and sizes specified at the locations shown on the Plans. Cable splices will be permitted only in lighting standard handholes, junction and/ or pull boxes and handboxes. Cable shall not be installed until the foundations and handboxes are in place.

Cable in conduit shall be installed in such a manner and by such methods as to prevent harmful stretching of the conductor, injury to the insulation, or damage to the other protective covering. The ends of all cables shall be sealed until ready for connection. Where more than one wire or cable is to be installed in a single duct or conduit, they shall be pulled into the conduits by hand or powered winch with the use of cable grips or pulling eyes. Pulling tension shall be governed by recommended standard procedures for straight pulls or bends. A lubricant is required. Provisions shall be made to allow for possible future cable installation by including a drawstring at the time of initial cable pull. Anticipated spare wire capacity of the conduit shall be as specified on the Plans.

Nondirect burial cable for lighting standards shall be three (3) conductor cable of size and type specified. The cable shall be installed in lighting shafts and brackets in a manner that will not stress conductors, insulation or sheath wall shall be supported at each luminaire with a cable clamp approved by the Engineer. The clamp may be an integral part of the luminaire or a device approved for the application. Cable installed shall be supported by cable grips approved by the Engineer and shall be in one continuous length without splices.

Ground conductors shall be placed as shown on the Plans. A complete grounding system shall be provided for electrical elements.

Precast concrete junction boxes shall be installed in accordance with the Standard Details at locations indicated on the Plans. Frames and covers shall be set flush with the finished grades. Where conduits enter boxes, the space between the conduit and wall shall be filled with grout or other sealer as

approved by the Engineer. After boxes are set to final grades, backfill shall be placed in 8 inch loose layers and thoroughly compacted to the satisfaction of the Engineer.

The Contractor shall furnish and install all control and distribution equipment, including equipment enclosures, panel boards, transformers, circuit breakers, contactors, photoelectric controls, selector switches, conduit, wiring and wiring devices, etc. to provide complete functioning control and distribution centers.

The concrete foundation pad shall be cast-in-place concrete of the dimensions shown on the Standard Details unless otherwise indicated on the Plans.

The control equipment cabinet shall be installed and suitably anchored to the pad as indicated on the Plans or Standard Details.

The Contractor shall make certain that all interconnecting wiring between devices and equipment cabinet and the noncurrent carrying parts of all devices in the cabinet shall be connected to the ground rod as indicated on the Plans or directed by the Engineer.

Ground rods shall be installed adjacent to the control and distribution equipment in handboxes and elsewhere, as indicated on the Plans. Maximum acceptable earth resistance value shall be 25 ohms, except at the distribution panel which will require 10 ohms.

Ground rods shall be driven as shown on the Plans. Ground resistance of each rod shall be measured before connecting the rod to the bare copper ground conductor. If the measured resistance exceeds 25 ohms, a 10 foot (3m) extension rod shall be exothermically welded to the top of the first rod then driven to its full depth. Earth resistance shall again be measured; and if it shall still exceed 25 ohms, the above procedure shall be repeated until specified ground resistance is obtained. If the rod cannot be extended, the Engineer shall be contacted for instructions.

Where rock is encountered and acceptable, earth grounds cannot be accomplished by driving as described above, the Engineer may direct the use of a grounding grid utilizing direct buried rods exothermically welded end to end to bond lighting standards and structures in continuous series to some point where an acceptable earth ground can be obtained.

B. Traffic Signalization

Traffic signal heads shall be installed as shown on the Plans or as directed by the Engineer.

The signal shall mount to standard 1-1/2 inch (40mm) fittings as a single section, as a multiple section face or in combination with other signals. The signal section shall be provided with an adjustable connection that permits incremental tilting from 0 to 10 degrees below the horizontal while maintaining common vertical axis through couplers and mounting.

Mounting attachments shall permit external adjustment about the mounting axis in five (5) degree increments.

Signal heads, which are to be rigid mounted shall be done so by the use of an adjustable signal bracket.

Signal heads shall be aimed to provide maximum safety to the traveling public by exposing maximum lens face.

Pedestrian signal heads mounted on poles or pedestals shall be mounted so that no portion of the mounted signal assembly shall be closer than 2 feet (0.6 m) to the face of the curb. All signal heads on the same pole or pedestal shall be within 6 inches (150 mm) of being at the same height unless otherwise specified on the Plans.

All trunnions, brackets and suspensions shall be painted bronze as directed by the Engineer.

Traffic signal conduit shall be installed to the lines and depths indicated on the Plans and in accordance with the specifications for lighting conduit.

Traffic signal electrical cable shall be installed to the lines and depths indicated on the Plans. Trenching and backfill shall be as specified for lighting cable.

Loop detector lead-in wire shall consist of one continuous run with no splices.

Loop lead-in wires terminating in the controller or detector cabinet shall be twisted and uniquely identified by an insulated waterproof sleeve slipped over the wire before attachment of a lug connector.

The two wires from the loop saw cut, which form the lead-in wires, shall be twisted together with a minimum of one turn per foot from the loop itself to the terminal point as shown.

Loop lead-in wire shall be sleeved as specified on the Plans. The sleeve shall be used between the roadway edge and the terminal point.

Loop wire shall be installed at the bottom of the saw cut slot. A blunt instrument shall be used to seat the loop wire at the bottom of the slot or channel. No sharp tools shall be used for this purpose. It shall have no kinks or curls and no straining or stretching of the insulation around the corner of the slot or in the handbox or pole base.

Wire with cuts, breaks or nicks in the insulation will not be accepted. All loops shall be wound in a counterclockwise direction.

After placing the wire, it shall be rechecked for slack, raised portions and tightness.

All loops shall be tested for continuity by a method approved by the Engineer before sealing.

Saw cuts shall be made with a power saw to the width and depth shown on the Plans or Standards.

All 90 degree corners where loop wires turn shall be made as two 135-degree cuts.

Saw cuts shall be cleaned, dried and free from dust, grit oil and moisture before the placement of wire.

Saw cutting of curbs will not be permitted.

Sealer for saw cuts shall be approved by the Engineer. The sealer shall be applied according to the manufacturer's directions and specifications.

The sealer shall be poured into clean, dry saw cuts when the temperature is at least 50 degrees Fahrenheit (10 degrees Celsius). The sealer shall not be poured during precipitation of any kind or when the temperature can be expected to fall below 50 degrees Fahrenheit (10 degrees Celsius) within one hour after the sealer is poured.

In applying the sealer, the Contractor shall insure that there is minimum spillover on the roadway along the saw cut.

When the sealer hardens, there shall be a smooth surface with no bulges or depressions.

The Contractor shall make certain that the sealer is hardened before allowing traffic to move over the area.

Loop detector amplifiers shall be installed in controller cabinets at locations shown on the Plans in accordance with NEMA Specifications and the manufacturer's recommendations.

Push buttons shall be installed where shown on the Plans or at other locations as directed by the Engineer.

Push buttons shall be located in such a manner so as to clearly indicate to the pedestrian which crosswalk or crosswalks are actuated by each push button as shown on the Plans or Standards.

The cable for push buttons shall be brought through the rear of each from a steel pole, controller cabinet or post. Entrance holes shall be grommeted.

Splicing of cable will not be permitted.

Signal poles and mast arms shall be installed on concrete footings as shown on the Plans. Pole shafts shall be plumb after erection.

Concrete footings shall be constructed as detailed on the Plans and in accordance with the specifications for foundations. Bolt circle data shall be in accordance with the approved shop drawings of the signal pole fabricator.

Pedestal poles shall be fabricated in accordance with the Standard Details and installed on concrete footings in accordance with the Plans. Pole shafts shall be plumb after erection.

Concrete footings for pedestal poles shall be constructed as detailed on the Plans and in accordance with the Specifications for Foundations.

Strain poles shall be installed on concrete footings in accordance with the Plans.

Concrete footings for strain poles shall be constructed as detailed on the Plans and in accordance with the Specifications for Foundations.

Span wire shall be attached to poles by wrapping two full turns of the span wire around the pole at the specified height.

The free end of the wrapped span wire shall be 2 foot (0.6 m) in length and shall be secured to the traversing span wire by a galvanized 6 inch (150 mm) bolt clamp with three 5/8 inch (16 mm) bolts and thimbles.

Before erecting span wire, the Contractor shall determine the length of suspension strand required to span the distance between the poles indicated on the drawings. A sufficient additional length of span wire shall be allowed to compensate for sag of pole connections and adjustments to make the whole assembly consistent with the typical installation drawings.

All support rings shall be spaced 10 inches (250 mm) apart.

The Contractor shall not erect any span which lays on or which may rub a utility company wire or cable. If a span wire as erected is within 6 inches (150 mm) of any other cable, wire or structure, it shall be protected with plastic wire guards. The Contractor shall comply with other requirements as dictated by law and the utility companies.

Ground systems shall be provided for all electrical components as indicated on the Plans or as directed by the Engineer. Ground systems shall meet the requirements of the National Electrical Code.

Ground rods shall be installed adjacent to the control and distribution equipment in handboxes and elsewhere, as indicated on the Plans. Maximum acceptable earth resistance value shall be 25 ohms, except at the distribution panel which will require 10 ohms. Ground rods shall be driven as shown on the Plans. Ground resistance of each rod shall be measured before connecting the rod to the bare copper ground conductor. If the measured resistance exceeds 25 ohms, a 10 foot (3 m) extension rod shall be exothermically welded to the top of the first rod then driven to its full depth. Earth resistance shall again be measured; and if it shall still exceed 25 ohms, the above procedure shall be repeated until specified ground resistance is obtained. If the rod cannot be extended, the Engineer shall be contacted for instructions.

Where rock is encountered and acceptable, earth grounds cannot be accomplished by driving as described above, the Engineer may direct the use of a grounding grid utilizing direct buried rod exothermically welded end to end to bond lighting standards and structures in continuous series to some point where an acceptable earth ground can be obtained.

C. Foundations

Concrete shall be mixed, placed and tested in accordance with Section 03300. Footings and bolt circle data shall be as shown on the Plans or in accordance with approved shop drawings. Anchor bolts shall be plumb. Suitable templates for setting anchor bolts shall be accurately set at the top of the bolts and left in place until concrete has obtained initial set.

Galvanized parts that have been cut or chipped to bare metal shall be regalvanized or repaired to the satisfaction of the Engineer.

The Contractor shall perform all excavation to meet lines for the levels and dimensions shown on the Plans. All excavation works will be inspected and approved by the Engineer before proceeding with construction.

Conduits, reinforcement ground rods and anchor bolts shall be set as detailed on the Plans before placing concrete.

It is intended that all concrete be placed against undisturbed earth. However, where the existing ground will not retain its shape during or after augering, or if the excavation should show any tendency to cave in before placing the foundation, the Contractor shall provide a sleeve or form to retain the earth and receive the concrete.

The sleeve shall be composed of sheet steel formed to the required shape and shall be carefully placed to the specified depth. As the concrete is poured, the sleeve shall be carefully withdrawn so that the wet concrete will flow into intimate contact with the sides of the excavation. When the sleeve is entirely withdrawn, above grade form and template and complete foundation shall be provided.

Tops of foundations shall be screeded to a dense, smooth finish. Exposed surfaces shall be cured by use of a liquid membrane curing compound.

Where rock or bolder is encountered, it shall be removed to the levels and dimensions shown on the Plans, or in the opinion of the Engineer, to that depth necessary to obtain the stability required. If water table or unusual soil conditions different from those anticipated are encountered excavation depth shall be modified as directed by the Engineer.

Material used for backfill shall be free from topsoil, loam, organic, frozen or other undesirable material. No trash shall be allowed to accumulate in the spaces to be backfilled, and these spaces shall be well cleaned before backfill is placed. Backfill material shall be material from the excavation or other sources as approved by the Engineer. All backfill shall be carefully compacted in layers not exceeding 8 inches (200 mm) in loose thickness and compacted with mechanical or vibratory compaction equipment to at least 92 percent of maximum density at a moisture content within two (2) percent of the optimum in accordance with ASSHTO T-180, Method C.

4. Measurement and Payment

- A. **Conduit for lighting and signalization will be measured for payment by the linear foot for the various types and sizes provided and shall include all fittings, connections and bushing. Payment will be made for the quantities measured for each size at the unit price per linear foot listed in the Bid Schedule. Payment will include furnishing and installing conduit and for all materials, labor, equipment, excavation, backfill and incidentals necessary to complete the work.**

- B. **Electrical cable for lighting and signalization will be measured for payment by the linear foot for the various types and sizes furnished and installed, complete in place and accepted. Payment will be made for the quantities measured for each size and type at the unit price per linear foot listed in the Bid Schedule. Payment will include furnishing and installing cable, materials, labor, trenching, backfilling, equipment and incidentals necessary to complete the work.**

- C. **Loop Detectors will be measured for payment by the linear foot of loop detector cable placed. Saw cuts will include the linear foot of saw cut including sealer as actually constructed. Payment will be made for the quantities measured at the unit price per linear foot listed in the Bid Schedule. Payment will include sealer, miscellaneous hardware, wiring and all labor and incidentals necessary to complete the work.**

- D. **Handboxes and junctions boxes will be measured for payment by each box installed of the type specified, complete in place including frames and covers, ground wire, excavation, backfill and miscellaneous hardware. Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.**

- E. **Lighting standards for street and entrance lighting will be measured for payment by each pole and fixture installed complete in place including concrete foundations. Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.**

- F. **Lighting system control and distribution equipment will be measured for payment per each complete in place including photoelectric controls, enclosures, panel boards, breakers, concrete foundations and all other equipment necessary to provide a power supply to the lighting system. Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.**

- G. **Signal heads will be measured for payment per each, complete in place, including all materials, labor, equipment and incidentals necessary to complete the work. Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.**

- H. Loop detector amplifiers will be measured for payment per each, complete in place, including wiring, electrical connections and all miscellaneous hardware. Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.**

- I. Push buttons and push button sign will be measured for payment per each complete, in place, including all materials, labor, wiring, hardware, fittings and incidentals necessary to complete the work. Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.**

- J. Signal poles with mast arms, pedestal poles and strain poles will be measured for payment per each, complete, in place, including concrete, anchor bolts, reinforcing steel, ground rods, ground wire, miscellaneous hardware, equipment, labor and incidentals necessary to complete the work. Payment will be made for the quantities measured at the unit price per each listed in the Bid Schedule.**

- K. Steel span wire of the size specified will be measured for payment by the linear foot of material installed complete including all hardware and incidentals necessary to complete the work. Payment will be made for the quantities measured for each size at the unit price per linear foot listed in the Bid Schedule.**