

**UNIFORM STANDARD  
SPECIFICATIONS  
for  
PUBLIC WORKS  
CONSTRUCTION**

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**1999  
ARIZONA  
Metric Edition  
(Includes revisions through 2000)**

## FOREWORD

Publication of these Uniform Standard Specifications for Public Works Construction fulfills the goal of a group of agencies who joined forces in 1966 to produce such a set of documents. Subsequently, in the interest of promoting county-wide acceptance and use of these standards, the Maricopa Association of Governments accepted their sponsorship and the responsibility of keeping them current and viable.

These specifications, representing the best professional thinking of representatives of several Public Works Departments, reviewed and refined by members of the construction industry, were written to fulfill the need for uniform rules governing public works construction performed for Maricopa County and the various cities and public agencies in the county. It further fulfills the need for adequate standards by the smaller communities and agencies who could not afford to promulgate such standards for themselves.

A uniform set of specifications, updated and embracing the most modern materials and construction techniques will redound to the benefit of the public and the private contracting industry. Uniform specifications will eliminate conflicts and confusion, lower construction costs, and encourage more competitive bidding by private contractors.

The Uniform Standard Specifications for Public Works Construction will be revised periodically and reprinted to reflect advanced thinking and the changing technology of the construction industry. To this end a specifications committee has been established as a permanent organization to continually study and recommend changes to the specifications. Interested parties may address suggested changes and questions to:

Standard Specifications & Detail Committee  
c/o Maricopa Association of Governments  
302 North 1<sup>st</sup> Avenue, Suite 300  
Phoenix, Arizona, 85003.

These suggestions will be reviewed by the committee and appropriate segments of the industry and cumulative annual revisions will be published the first of each year.

While in the interest of uniformity, it is hoped that all using agencies will adopt these standards with as few changes as possible, it is recognized that because of charter requirements and for other reasons, some agencies will find it necessary to modify or supplement certain requirements.

### **Please Read and Set Aside**

The following list of pages which are included in this revision contain typographical or grammatical changes that do not effect the overall meaning of this document. Therefore no bars or revision dates are reflected on these pages.

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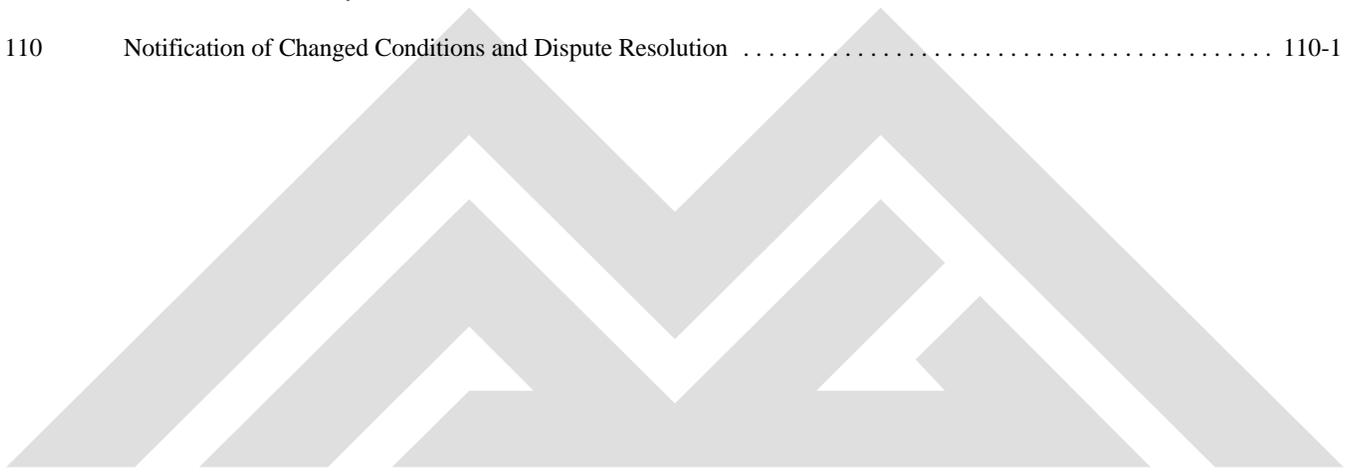
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## SECTION 108

### COMMENCEMENT, PROSECUTION AND PROGRESS

#### 108.1 NOTICE TO PROCEED:

(A) On Bond Issue and Budget Projects, neither the Contractor nor any Subcontractor shall commence work on a project prior to receipt of the written Notice to Proceed from the Contracting Agency. The Contractor shall commence work as soon as practicable after the starting date specified in the Notice to Proceed. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus extensions, beginning with the day following the starting date specified in the Notice to Proceed.

(B) On Improvement District Projects, the Contractor shall commence work within 10 days from the date of execution of the contract with the Contracting Agency. All work under the contract shall be completed within the number of calendar days stated in the proposal, plus any days extended on the contract, beginning with the day following the date of execution of the contract. The time set for completion of the project will be established by the Contracting Agency, in accordance with ARS Section 9-683.

The Contractor shall notify the Field Engineering Inspection Section 24 hours in advance of the time and place where work will begin and the Survey Section 2 working days in advance for staking.

#### 108.2 SUBLETTING OF CONTRACT:

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or contracts, or of his right, title, or interest therein, without written consent of the Contracting Agency.

Subcontracts shall be in accordance with and the Contractor shall be bound by the following provisions:

(A) All subcontracts shall be subject to the approval of the Engineer.

(B) All subcontracts shall be in writing and shall provide that all work to be performed thereunder shall be performed in accordance with the terms of the contract.

(C) Subcontractors shall conform to the regulations governing employment of labor.

(D) The subcontracting of any portion of the work will in no way release the Contractor of his liability under the contract and bonds.

(E) On all contracts for pipeline construction, roadway construction or roadway maintenance, the Contractor shall perform, with his own organization, work amounting to not less than 50 percent of the total contract cost.

On other types of contracts the individual agency shall determine the percentage or waive this requirement.

#### 108.3 CORRESPONDENCE TO THE CONTRACTOR:

A written notice, to the Contractor from the Contracting Agency, shall be considered delivered and the service thereof completed, when said notice is posted, by certified mail, to the said Contractor at his last given address, or delivered in person to the Contractor or his authorized representative on the work.

#### 108.4 CONTRACTOR'S CONSTRUCTION SCHEDULE:

The Contractor, when required, shall furnish the Engineer a construction schedule for his review. The Engineer's review of the Contractor's schedule is for purposes of: 1) the Contracting Agency's staffing the project as may be required; 2) to insure general compliance with the contract documents as it relates to the completion of all work; and 3) to monitor and evaluate the construction status for purposes of approving progress payments. In the event the schedule does not contain sufficient information to meet the above purpose, as determined by the Engineer, the Contractor shall resubmit a new schedule with the additional information requested by the Engineer. The right to determine the sequence of the work is a function vested solely in the Engineer and the construction schedule, when established, shall not be changed without the written consent of the Engineer. The orderly procedure of all work to be performed shall be the full responsibility of the Contractor.

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Review of a submitted schedule by the Engineer shall in no way be construed as an affirmation or admission that the schedule is reasonable or workable which responsibilities remain the obligations of the Contractor. When the schedule shows a completion prior to the contract completion date, this extra time between the contract completion date and the scheduled completion date (float), may be used by the Contracting Agency without additional compensation to the Contractor. The Contracting Agency shall not be liable to the Contractor for any damages for delay if the Contractor completes the work prior to expiration of the original Contract completion date or as modified by approved change orders, if any.

### **108.5 LIMITATION OF OPERATIONS:**

The Contractor shall conduct the work at all times in such a manner and sequence that will assure the least interference with traffic and inconvenience to the public. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

All traffic affected by the construction will be regulated in accordance with the current Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department.

Except in emergencies endangering life or property, written permission shall be obtained from the Engineer to perform any work after regular working hours, on weekends, or legal holidays. Prior to the start of such work, the Contractor shall arrange with the Engineer for the continuous or periodical inspection of the work, surveys and tests of materials, when necessary.

If, in the opinion of the Engineer, the Contractor has fallen behind the approved progress schedule, the Contractor shall take such steps as may be required by the Engineer, including but not limited to, increasing the number of personnel, shifts, and/or overtime operations, days of work, and/or amount of construction equipment until such time as the work is back on schedule. He shall also submit for approval no later than the time of submittal of the next request for partial payment, such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the approved rate of progress will be regained, all at no additional cost to the Contracting Agency.

### **108.6 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT:**

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

All workmen shall be competent and have sufficient skill, knowledge and experience in their class of work and in the operation of equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed from the work by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer. The Contractor or Subcontractor shall keep the Contracting Agency harmless from damages or claims for compensation that may occur in the enforcement of this section.

Should the Contractor or Subcontractor fail to remove such person as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that it will not damage property adjacent to the work area.

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

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If payment will be longer than 60 days after final completion and acceptance, the owner will provide the Contractor specific written findings for reasons justifying the delay in payment.

The acceptance of the project and the making of the final payment shall not constitute a waiver by the Contracting Agency/Owner of any claims arising from faulty or defective work appearing after the completion or from failure of the Contractor to comply with the requirements of the contract documents.

### 109.8 PAYMENT FOR DELAY:

The procedures contained in this Subsection shall not be construed to void any provision of the contract which require notice of delays, provides for negotiation of other procedures for settlement or provide for liquidated damages.

**109.8.1 Failure to Locate or Incorrect Location of Utilities:** ARS 40-360 states “that if the owner or operator fails to locate or incorrectly locates the underground facility, pursuant to this article, the owner or operator becomes liable for resulting damages, costs and expense to the injured party.” The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

**109.8.2 Contracting Agency Delays:** ARS 34-221 states “A contract for the procurement of construction shall include a provision which provides for negotiations between the Agent and the Contractor for the recovery of damages related to expenses incurred by the Contractor for a delay for which the Agent is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract.”

In this case, if the Contractor sustains damages which could not have been avoided by the judicious handling of forces, equipment and plant or by reasonable revision in the Contractor's schedule of operation, the compensation for such damages will be negotiated. The Contractor shall notify the Engineer of the condition in writing by the next work day. Failure to notify the Engineer within this time may be just cause to reject any claims for such damages.

Compensation for such damages will be negotiated as follows:

(A) The Engineer shall be satisfied that the Contractor has made every reasonable effort to prosecute the work despite any delays encountered or revisions in the Contractor's scheduling of work.

(B) The Compensation paid to the Contractor shall be in accordance with Section 109.

**109.8.3 Extension of Contract Time:** For any such delays, the contract time will be adjusted in accordance with Subsection 108.7.

### 109.9 DOLLAR VALUE OF MAJOR ITEM

TABLE 109-1	
DOLLAR VALUE OF MAJOR ITEM	
Original Contract Amount	Dollar Value of Major Item
\$0.00 to \$1,000,000.00	\$50,000 or 10% of original contract amount, whichever is less
\$1,000,000.00 to \$5,000,000.00	5.0% of original contract amount
\$5,000,000.00 or greater	\$250,000.00 or 2.5% of original contract amount, whichever is greater

End of Section

## SECTION 110

### NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

#### 110.1 GENERAL:

When changes are initiated by the Contracting Agency, or as a result of decisions rendered by the Agency, inaction of the Agency or changed conditions unknown to all parties at the time of bid, the Contractor may request an adjustment to the contract amount and/or contract time. This section does not preclude the use of legal remedies in the event of claims or litigation brought by third parties. The procedure for this adjustment is a two step process, 1) Initial Notification and Dispute Resolution and 2) Administrative Process for Dispute Resolution, as discussed below:

#### 110.2 INITIAL NOTIFICATION AND DISPUTE RESOLUTION:

**110.2.1 Notification:** As required by these Specifications or any time the Contractor believes that the action or decision of the Contracting Agency, lack of action by the Contracting Agency, or for some other reason will result in or necessitate the revision of the contract, the Engineer must be notified immediately. If within two working days the identified issue has not been resolved between the Contracting Agency and the Contractor, the Contractor shall provide a written notice. At a minimum, the written notice shall provide a description of the nature of the issue, the time and date the problem was discovered, and if appropriate, the location of the issue. After initial written notice has been provided, the Engineer will proceed in accordance with Subsection 104.2. In addition to proceeding in accordance with Subsection 104.2, the Contracting Agency and the Contractor must make every effort to resolve the issue identified in the initial notice. Only if the issue cannot be quickly resolved will it be necessary to proceed to the next step in this subsection.

**110.2.2 Dispute Resolution:** Once the above process has been exhausted or within seven calendar days of the date of the initial written notice, whichever is sooner, the following steps will be taken:

(A) The Contractor shall provide in writing the following information to the Engineer. If known, a cost analysis may be included with the information.

- (1) The date of occurrence and the nature and circumstances of the issue for which initial notice was given.
- (2) Name, title, and activity of each Contracting Agency or all other persons knowledgeable of the issue.
- (3) Identity of any documents and the substance of any oral communication related to the issue.
- (4) Basis for an assertion that the work required is a change from the original contract work or schedule.
- (5) Identity of particular elements of contract performance for which a change in compensation and/or time may be sought, including:
  - (a) Pay item(s) that have been or may be affected by the issue and any adjustments to unit price(s) that are required;
  - (b) Labor and/or materials that will be added, deleted or wasted by the problem and what equipment will be idled or required;
  - (c) Delay and disruption in the manner and sequence of performance that has been or will be caused;
  - (d) Adjustments to delivery schedule(s), staging, and contract time due to the dispute and
  - (e) Estimate of the time within which the Contracting Agency must respond to the notice to minimize cost, delay, or disruption of issue.
- (6) Any other items or information germane to the dispute.
- (7) The Contractor's written certification, under oath, attesting to the following:
  - (a) The request is made in good faith.
  - (b) Supportive data is accurate and complete to the Contractor's best knowledge and belief.
  - (c) When provided, the amount requested accurately reflects the Contractor's actual cost incurred.

In complying with this request, the Contractor shall use the Contracting Agency's certification form.

(B) Within ten calendar days after the Contractor's submission in accordance with the above paragraph, the Engineer will respond in writing to the Contractor to:

- (1) Confirm that a supplemental agreement is necessary and, when necessary, give appropriate direction for further performance, or
- (2) Deny that the contract has been revised and, when necessary, direct the Contractor to proceed with the contract work, or

## SECTION 110

- (3) Advise the Contractor that adequate information has not been submitted to decide whether (1) or (2) applies, and indicate the needed information and date it is to be received by the Engineer for further review. The Contracting Agency will respond to such additional information within ten calendar days of receipt from the Contractor.

**110.2.3 Conditions:** The failure of the Contractor to comply with the requirements of this subsection constitutes a waiver of entitlement to additional compensation or a time extension.

### 110.3 ADMINISTRATIVE PROCESS FOR DISPUTE RESOLUTION:

**110.3.1 General:** If the Contractor rejects the decision of the Engineer in Subsection 110.2.2 (B) above, the Contractor may begin the Administration Process to resolve the dispute.

The notice provision set forth in Subsection 110.2 is a contractual obligation assumed by the Contractor in executing the contract. It is understood that the Contractor will be forever barred from recovering against the Contracting Agency if the Contractor fails to give notice of any act or failure to act, by the Engineer, or the happening of any event, thing, or occurrence, in accordance with Subsection 104.2 Alteration of Work.

The administrative process for the resolution of disputes is sequential in nature and is composed of the following levels:

- Level I. (Representative reviewed by: *e.g. Construction Engineer*)
- Level II. (Representative reviewed by: *e.g. Assistant County/City Engineer*)
- Level III. (Representative reviewed by: *e.g. County/City Engineer*)

Note: The above stated titles may vary depending on the Contracting Agency's organization.

These three levels of review; the specific titles; the financial authority of each; and the names of people assigned to each level shall be provided at the preconstruction conference. The equivalent information regarding the Contractor's organization shall also be provided at the preconstruction conference.

Except as provided elsewhere herein, no dispute will be accorded a particular level of review unless the dispute has been reviewed at the preceding level and the Contractor rejects the decision in writing within the time period specified, or both parties agree that the decision for compensation is above that levels authority.

Unless specifically requested otherwise by the Contracting Agency, submission of additional information by the Contractor or Engineer, at any level of the review process shall cause the process to revert to Level I.

**110.3.2 Required Information:** At a minimum, the information described in Subsection 110.2 must accompany each dispute. If the following applies, it shall also be provided in addition to the information required by Subsection 110.2.

(A) If additional compensation is sought, the Contractor shall submit the exact amount sought as required by Subsection 110.2.2

(A) (5) broken down into the following categories:

- (1) Direct Labor
- (2) Direct Materials
- (3) Equipment
- (4) Job Overhead
- (5) General and Administrative Overhead
- (6) Subcontractor's Work (broken down as 1, 2, 3 and 4 above)
- (7) Other categories as specified by the Contractor.

(B) If additional time is sought, the Contractor shall provide a comprehensive time impact analysis showing the delay(s) and how they affect the critical path. The time impact analysis must include both the original and as-built critical path schedules and must be supported by documentation such as delivery schedules, invoices, correspondence, memoranda of telephone calls, payroll data, daily work schedules, etc. NOTE: The path of the longest duration of continuous and dependent work activities through the schedule network is identified as the Critical Path and is the minimum amount of time required to build the project as depicted by the schedule.

## SECTION 110

(C) The Contractor shall also notify the Contracting Agency's Level I Representative in writing that all documentation in support of the dispute has been provided and that the administrative review process should begin. No formal action will be taken by the Level I Representative until this written notification is received. The documentation provided to the Level I Representative shall serve as the basis for evaluating the Contractor's position regarding the dispute throughout the administrative process.

**110.3.3 Process:** The Contracting Agency's Level I Representative will render a written decision regarding the matter in dispute within two working days of receipt of the Contractor's notification that the dispute resolution process should begin.

The Contractor shall, upon receipt of the decision by the Level I Representative, either accept or reject the decision in writing. If the Contractor does not reject the Level I Representative's decision within two working days of its receipt, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level I Representative, the dispute will be forwarded by the Level I Representative to the Level II Representative. The Level II Representative will, within seven working days of receipt of the dispute information from the Level I Representative, schedule and hold a meeting to review the dispute with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level II Representative will, within seven working days of the meeting, issue a written decision, with justification, regarding the dispute.

The Contractor shall, within seven working days of receipt of the decision, either accept or reject it in writing. If the Contractor does not reject the Level II decision within seven working days, the Contractor will be deemed to have accepted the decision and the dispute will be considered withdrawn from the administrative process and there will be no further remedy.

If the Contractor rejects the decision of the Level II Representative, the Level II Representative will forward the dispute to the Level III Representative. The Level III Representative will, within fourteen working days of receipt of the dispute information from the Level II Representative, schedule and hold a meeting with the Contractor. This time limit may be extended by mutual agreement of the parties. The Level III Representative will, issue a written decision within fourteen working days of the meeting, with justification, regarding the dispute.

The Contractor shall, within fourteen working days of the receipt of the decision of the Level III Representative, either accept or reject it in writing. If the Contractor does not reject the Level III Representative's decision within fourteen working days, the Contractor will be deemed to have accepted the decision, the dispute will be considered withdrawn from the administrative process, and there will be no further remedy.

If the Contractor rejects the decision of the Level III Representative, there will be no further administrative review of the dispute. The resolution will then proceed as follows:

**A) Mediation:** Prior to filing for arbitration or litigation, the Contractor may request non-binding mediation by filing a request for mediation in writing with the Engineer. If agreeable, the Engineer will then arrange for a mutually agreeable mediator. Such request for mediation shall be made within thirty calendar days from the date of the Level III Representative's decision as provided for in this subsection.

In connection with the mediation, each party shall bear its own costs, attorney's fees, and expert fees. Any fees and expenses assessed by the mediator shall be borne equally by the parties.

**B) Dispute Review Board/Arbitration:** The decision of the Level III Representative in relation to the claim shall be final unless the dispute review board or arbitration is chosen as follows:

(1) Where the amount in controversy is less than or equal to the amount authorized in Subsection 110.3.4, the sole remedy shall be the Dispute Review Board as prescribed in Subsection 110.5 unless both parties mutually agree to utilize arbitration as prescribed in Subsection 110.4.

(2) Where the amount in controversy is more than authorized in Subsection 110.3.4, the Contractor reserves the right to initiate litigation pursuant to Section 12-821 et seq. of the Arizona Revised Statutes, or if mutually agreed upon, the parties may choose to resolve the controversy utilizing either the Dispute Review Board as prescribed in Subsection 110.5 or Arbitration as prescribed in Subsection 110.4.

## SECTION 110

**110.3.4 Amount of Dispute:** For the purposes of this subsection, the amount in controversy may not exceed \$200,000.00. A claim for adjustment in compensation shall mean an aggregate of operative facts giving rise to the rights of the party for which it is seeking to enforce. That is to say, a claim under this subsection is defined as the event, transaction or set of facts that give rise to a claim for compensation, costs, expenses or damages.

In making a determination whether the amount in controversy is \$200,000.00 or less, the parties shall not consider, quantify or take into account any requested extensions of contract time, or the release or remission of liquidated damages assessed or accrued prior to the dispute in question, under Subsection 108.7 and 108.9 of the Specifications.

Any party having a claim, adjustment or dispute for an amount in excess of \$200,000.00 may waive or abandon the dollar amount of any such claim in excess of \$200,000.00 so as to bring the claim, adjustment or dispute within the scope and coverage of this subsection, provided that the amount allowed to any such party by the arbitration award shall not exceed \$200,000.00. Various damages claimed by the party for a single claim may not be divided into separate proceedings to create claims within the \$200,000.00 limit.

### **110.4 ARBITRATION:**

If the parties mutually agree to pursue arbitration as prescribed in Subsection 110.3.3, then a Demand for Arbitration shall be filed in writing with the American Arbitration Association or United States Arbitration and Mediation of Arizona, and a copy served thereof upon the Level III Representative or Contractor, whichever applicable. Such Demand for Arbitration shall be made by the party within thirty calendar days of the date of the Level III Representative's decision as provided for in Section 110.3 above, unless a mediation process is already underway, in which case the Demand for Arbitration shall be made within thirty days of the termination of the mediation process. The scope of the arbitration proceeding shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. All arbitration of claims shall be conducted in Phoenix, Arizona or other mutually selected location in accordance with the rules of the arbitration service hearing the dispute.

The claim shall be submitted to a single arbitrator who shall be selected by the parties from a list of arbitrators furnished by the arbitration service. Each party shall alternately strike names from the list until only one name remains. The person whose name thus remains on the list of arbitrators is their first choice, but if that person is not available to serve, the two persons whose names were last stricken are acceptable, with the one whose name was last stricken being the first alternate.

Unless agreed to otherwise, the parties shall select the arbitrator within ten calendar days after each has received a copy of the list of arbitrators.

Each party to the arbitration shall bear its own costs, attorney fees and expert fees. Any other costs and fees assessed by the arbitration service shall be divided equally between the parties to the arbitration.

The decision or award of the arbitrator shall be supported by substantial evidence and, in writing, contain the basis for the decision or award and findings of fact. The decision or award by the arbitrator when made shall be final and nonappealable except as provided in Section 12-1512, Arizona Revised Statutes. Both parties to the Contract shall be bound by the Arbitration Award for all purposes and judgement may be entered upon it in accordance with applicable law in the Superior Court of Arizona.

### **110.5 DISPUTE REVIEW BOARD:**

If the Dispute Review Board is utilized as prescribed in Subsection 110.3.3, the Engineer shall be notified within thirty days after the Level III Representative decision. The Dispute Review Board is a three member board independent of the parties involved in the issue. The Agency and Contractor shall each select a member for this board. The third member shall be a mutually agreed upon independent member. This Review Board must be selected within fourteen calendar days after notice to the Level III Representative. Each member shall agree to impartially serve the Agency and Contractor. Fees and expenses of Board Members are to be shared equally by Agency and Contractor. The Dispute Review Board shall meet within thirty days of the selection of the board, unless, by mutual agreement, another date is selected. The scope of the Dispute Review Board shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. The Board shall consider and evaluate the dispute and render a written decision that assigns financial responsibilities and allocates adjustments in the contact time, if applicable, within seven calendar days after the meeting. The decision of the dispute Review Board will be final.

**SECTION 110**

**110.6 FINAL DOCUMENTATION AND PAYMENT:**

If at any step in the process a dispute is resolved, the Contractor must sign a supplemental agreement setting forth the resolution of the dispute and including an unconditional release as to any and all matters arising from the dispute. In addition, when the agreement results in a change in contract amount and/or time, a change order shall be prepared by the Contracting Agency for said changes and signed by both parties within 30 days from the date of the agreement. Payment of the change order will be made to the appropriate party(s) in accordance with Section 109.

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End of Section

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**PART 200**  
**EARTHWORK**

<b>Section</b>	<b>Title</b>	
201	Clearing and Grubbing .....	201-1
205	Roadway Excavation .....	205-1
206	Structure Excavation and Backfill .....	206-1
210	Borrow Excavation .....	210-1
211	Fill Construction .....	211-1
215	Earthwork for Open Channels .....	215-1
220	Riprap Construction .....	220-1
225	Watering .....	225-1
230	Dust Palliative Application .....	230-1



## SECTION 230

### DUST PALLIATIVE APPLICATION

#### 230.1 DESCRIPTION:

This section shall govern the application of dust control palliatives (agents) on unpaved roads, traffic surfaces, vacant lots, construction sites and road shoulders. Dust palliatives may also be used to protect erosion of slopes, embankments, sediment control and re-vegetated areas.

Dust palliatives may be applied as topical treatments to penetrate an undisturbed surface, or may be applied to larger areas using mixing methods that blend the product with surface material and then compact the mixture to provide a stabilized, dust resistant, surface course.

#### 230.2 MATERIALS:

Materials to be used as dust palliatives shall conform to the requirements of Section 792. The specific dust palliative to be used shall be as shown on the plans or as directed by the Engineer.

Water used for diluting dust palliatives and for pre-wetting of treated subgrade shall be either potable or from a source compatible with dust palliative ingredients.

#### 230.3 EQUIPMENT:

The Contractor shall provide all equipment necessary to complete the work. The equipment may include but not be limited to motorized graders, distribution trucks, mixing and pulverizing equipment, pneumatic-tired rollers, sprinkler systems, etc. All equipment used for this work is subject to approval by the Engineer. Equipment that does not perform satisfactorily shall be removed from the job.

Distributor trucks shall be pressure type with a computer-controlled applicator. Spray bars and extensions on distribution trucks shall be of the full circulating type. The spray bar shall be adjustable to permit varying height above the surface to be treated.

#### 230.4 PREPARATION OF SURFACE:

All surface preparation shall be in conformance with Maricopa County Rule 310 and 310.01 as applicable.

**230.4.1 Topical Preparation:** Prior to the application of the dust palliative, the surface shall be graded to provide drainage.

Unless otherwise stated in the manufacturer's technical data, all areas to receive the dust palliative shall be uniformly moistened. Moisture must be maintained on the surface until the time of the application. Dust palliatives shall not be applied when the surface is excessively wet or saturated.

**230.4.2 Surface Course Preparation:** Areas to receive dust palliative shall be graded and scarified to at least the minimum depth and width shown on the plans. The material shall be damp at time of scarification to reduce dust and aid in pulverization. Soil clods shall be pulverized until all material, exclusive of gravel or stone, will pass a 1½-inch sieve.

All debris, weeds, organic material, stone larger than 4-inches, etc. shall be removed from the site. Surface gravel or stones shall be removed or thoroughly mixed with the surrounding soils to obtain a homogeneous mixture.

If pre-wetting is required, ample amount of water shall be added and mixed with the in-place material to obtain a moisture content near optimum. This moisture content shall be established prior to and maintained until the application of the dust palliative. The methods to establish and maintain the moisture shall be done in accordance with manufacturer's recommendations. The moisture must be uniformly distributed throughout the surface course and over the underlying undisturbed soil. Dust palliatives shall not be applied when the soil is excessively wet or saturated. Moisture content shall be determined in accordance with either ASTM D 2922, D 3017 or D 4944.

## SECTION 230

### 230.5 APPLICATION:

230.5.1 General: The dust palliative shall be applied by a pressure type distributor truck. Spray bars and extensions shall be of the full circulating type. Valves which control the flow from nozzles shall be of a positive active design so as to provide a uniform, unbroken spread of dust palliative on the surface.

Corners or surface that cannot be accessed by the distributor truck shall be hand sprayed by means of hoses or bars pressurized by a gear pump or air tanks.

The distributor shall be equipped with certified meter or weight tickets and calibration charts relating to the specific gravity of the concentrate and/or dilution to provide for accurate, rapid determination and control of the amount of dust palliative being applied. The spreading equipment shall be designed so that uniform application of a dust palliative can be applied in controlled amounts ranging from 0.05 to 2.00 gallons per square yard.

The dust palliative shall be applied at the dilution ratio and application rate specified in accordance with Section 792, unless otherwise directed by the Engineer. Products may be applied in multiple passes at reduced application rates to meet the total application rate specified and/or assure uniform coverage.

**230.5.2 Topical Application:** Topical applications shall be rolled only when recommended by the manufacturer. Complete penetration of palliative will be required prior to the surface rolling. Complete penetration occurs when the compaction equipment will not track or pick up the dust palliative and/or the top layer of the surface material.

**230.5.3 Surface Course Application:** Mixing shall be done in-place using mixing equipment or by motorized grader (blade mixing). The blending methods utilized shall result in a uniformly treated mixture of soil and dust palliative at or near optimum moisture content (minus any post-compaction dust palliative top coat application quantity). The dilution ratio may be adjusted to bring the mixture to the desired moisture content. The amount of area treated each day shall be limited to that which the Contractor can thoroughly mix and compact within that work day.

Complete penetration of palliative will be required prior to compaction. Complete penetration occurs when the compaction equipment will not track or pick up the blended material.

The blended material shall be shaped to the required grade line and cross section shown on the plans and be compacted at least 95% of maximum density in accordance with ASTM D 698, unless otherwise directed by the Engineer. The final surface shall be rolled to a smooth and even grade. Immediately after the compaction, a top coat of dust palliative shall be applied.

### 230.6 CURING:

No equipment or traffic will be permitted on the treated surface for 24 hours unless otherwise approved by the Engineer.

### 230.7 WEATHER CONDITIONS:

Dust palliatives shall be applied only when the ambient temperature is above 40 EF and there is no possibility of rainfall during or within 24 hours after placement. Application during high wind should be avoided.

### 230.8 MEASUREMENT:

Dust palliative surface course application shall be measured by the square yard [meter], in place, treated, compacted, to the proper depth and accepted.

Dust palliative materials will be measured by the ton of undiluted material. Any conversion from volumetric quantities shall be done with Contractor-supplied calibration charts relating to the specific gravity of the concentrate and/or dilution.

### 230.9 PAYMENT:

Payment will be made for the applicable items at the Contract unit prices bid in the proposal, and shall constitute full compensation for the item completed, as herein described and specified.

End of Section

## SECTION 309

The mix design shall comply with the following requirements:

- (a) pH: Minimum 12.4 after compaction of initial mixing with lime at ambient temperature, in accordance with Eades-Grimm pH test method (ASTM C977 APPENDIX).
- (b) Plasticity Index: Less than 3, per AASHTO T-89 & T-90.
- (c) Swell Potential: One (1) percent or less vertical expansion of an air dried soil when inundated with water and allowed to swell at a confined pressure of 2.88 Kpa.
- (d) Hydrated Lime Content: Minimum 5.0 percent by dry weight of the combined lime/soil mixture, per ASTM D-3155.
- (e) Unconfined Compressive Strength: Minimum 1104 Kpa in five days curing at 38°C. when tested in accordance with ASTM D-1633 Method A.

**309.3.3 Tolerance:** At final Compaction, the lime and water content for each course of subgrade treatment shall conform to the approved mix design with the following tolerance:

<u>Material</u>	<u>Tolerance</u>
Lime	+0.5% of design, (ASTM C-114)
Water	+4%, -0% of optimum, (ASTM D-698)

### 309.4 CONSTRUCTION:

**309.4.1 General:** It is the primary requirement of this specification to secure a completed subgrade containing a uniform lime mixture, free from loose segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface suitable for placing subsequent courses.

Prior to beginning any lime slurry stabilization, the subgrade shall be constructed and brought to grade and shall be shaped to conform to the typical sections, lines and grades as shown on the plans.

When the design requires treatment to a depth greater than 300 mm, the subgrade soil shall be treated in equal layers. The top layer(s) of soil shall be removed and stockpiled. The lower layer of soil to be treated shall then be treated and allowed to cure in place. After final mixing, the lower layer shall be compacted in maximum 300 mm compacted lifts. The stockpiled soil shall then be placed, treated, mixed and compacted in successive maximum 300 mm compacted lifts.

**309.4.2 Weather Limitation:** Lime slurry treated subgrade shall not be constructed if the atmospheric temperature is below 4.5° C. or when conditions indicate that temperatures may fall below 4.5 °C. within 24 hours.

**309.4.3 Equipment:** Contractor shall provide all equipment necessary to complete the work including grading and scarifying equipment, a spreader of the lime slurry (gravity feed spreader, will not be permitted), mixing and pulverizing equipment, sheepsfoot and pneumatic rollers, sprinkling equipment and trucks. When using dry hydrate to make slurry, agitators are mandatory in distributor trucks. All equipment used for this work is subject to approval by the Engineer.

**309.4.4 Application:** Lime slurry shall be spread only on that area where the mixing operation can be completed during the same working day. The application and mixing of lime with the soil shall be accomplished by the methods hereinafter described as Slurry Placing.

Slurry Placing: Lime slurry shall be mixed in a portable mixing unit and spread with trucks equipped with an approved distribution system as a slurry. Commercial lime slurry shall be applied with a lime percentage not less than specified herein. The distribution of lime slurry shall be attained by successive passes over a measured section of subgrade until the proper amount of lime has been spread, as determined in the job mix design. The rate of application shall be verified using the methods outlined by ASTM D-3155.

## SECTION 309

Thickness: The thickness of the lime slurry treated subgrade shall be determined by visual inspection and/or by depth tests taken at intervals so that each test shall represent no more than 836.1 square meters per layer. If more than one layer, the method used to remove material to determine the depth of lime treatment may be by shovel and/or pick, coring or other method approved by the Engineer. Phenolphthalein solution shall be used to detect the presence of lime. When the grade deficiency is more than 25 mm, the Contractor shall correct such areas in a manner satisfactory to the Engineer. Contractor shall replace, at no cost to the Agency, the material where depth tests are taken.

No traffic other than the mixing equipment will be allowed to pass over the spread of lime slurry until after completion of mixing.

The Engineer reserves the right to vary the rate of application of lime from the specified application rates during the progress of construction as necessary to maintain a pH of the lime/soil mixture above 12.4 and the desired characteristics of the treated subgrade.

**309.4.5 Mixing:** The full depth of the treated subgrade shall be mixed with an approved mixing machine. The use of disc plows or blades are strictly prohibited except in areas specified by the engineer. To insure a complete chemical reaction of the lime and soil or subgrade, water shall be used as required to maintain a minimum moisture content 4% above the optimum prior to beginning compaction and held at 0-4% above optimum during compaction. During the interval of time between application and mixing, lime that has been applied, unmixed and exposed to the open air for 10 hours or more will not be accepted.

After mixing and prior to compaction, clay lumps shall meet the following criteria:

	<u>Percent</u>
Minimum of clay lumps passing 37.5 mm sieve	100
Minimum of clay lumps passing 4.75 mm sieve	60

**309.4.6 Compaction:** Compaction of the mixture shall begin after final mixing. Sheepsfoot or segmented sheel rollers shall be used during initial compaction. Steel wheel or pneumatic tired rollers shall be used only during final compaction. Areas inaccessible to rollers shall be compacted to the required density by methods approved by the Engineer.

The material shall be aerated or watered as necessary to provide and maintain required moisture content. The field density of the compacted mixture shall be at least 95 percent of the maximum density at 0-4% above optimum moisture. A composite of untreated soil or subgrade materials from a minimum of five (5) random locations, per soil type, within the area to be stabilized shall be used to determine the maximum density and optimum moisture content in accordance with ASTM D-558. The in-place filed density shall be determined in accordance with ASTM D-1556, ASTM D-2167 or ASTM D-2922.

After each section is completed, tests will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked to meet requirements.

If pumping subgrade should become evident at any time prior to paving, the Engineer may require proof rolling with a pneumatic-tire roller or other approved equipment in order to identify the limits of the unacceptable area. The proof rolling will be performed at no additional cost to the Contracting Agency.

All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereupon or the work is accepted. Compaction and finishing shall be done in such a manner as to produce a smooth dense surface free of compaction planes, cracks, ridges or loose materials.

Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion, shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at no cost to the Agency.

**309.4.7 Finishing And Curing:** After the final layer or course of lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the plans. The completed section shall then be finished by rolling with a pneumatic or other suitable roller.

## SECTION 311

### SOIL CEMENT BASE COURSE

#### 311.1 DESCRIPTION:

This item shall consist of a base course composed of a mixture of local soil, portland cement, and water compacted at optimum moisture content.

#### 311.2 MATERIALS:

Portland cement and water shall comply with Sections 725 and 225. The soil for the mixture shall consist of the material in the area to be paved. The material shall not contain more than 5 percent gravel or stone retained on a 75 mm sieve. It shall be demonstrated by laboratory tests that the plasticity and hardening characteristics of the soil will be adequately modified by the specified cement content.

#### 311.3 EQUIPMENT:

An ample number of machines, combination of machines and equipment shall be provided and used to produce the complete soil cement base course meeting the requirements for soil pulverization, cement distribution, water application, incorporation of materials, compaction, finishing, and for application of the curing material as provided in these specifications.

Mixing shall be accomplished by means of multiple-pass soil-cement mixer, single-pass soil-cement mixer or central plant mixer.

Water may be applied through the mixer or with the water trucks equipped with pressure sprays. Water trucks providing fine fog-type sprays shall be furnished for finishing and curing. Properly adjusted garden type nozzles on a pressure bar may be used to produce fog spray if approved by the Engineer.

Cement spreader shall be a specially constructed device to distribute bulk cement uniformly at rate specified either in windrows or on the flat as determined by method of mixing.

#### 311.4 CONSTRUCTION METHODS:

Before undertaking construction of the soil cement base course, the area to be paved shall be brought to a compacted condition, true to line and grade as directed by the Engineer or as shown on the plans. During this process any unsuitable soil or material, including excess material retained on a 75 mm sieve, shall be removed and replaced with acceptable material. The compacted surface shall be at the proper elevation as specified, shown on the plans, or as directed by the Engineer, for the top of the soil cement base. At completion of this phase, the material and surface shall be approved by the Engineer before proceeding with the next step.

The material shall be scarified, pulverized, mixed with water and cement, compacted and finished and cured in lengths permitting the full roadway width to be complete in not more than 4 hours from the time that cement is exposed to water. Such lengths will generally be not less than 200 m or the length of one City block and preferably more. Where a gutter section exists the material shall be pulled back from the gutter face for the full depth of the course before processing.

**311.4.1 Pulverizing:** Before application of cement, soil to be processed shall be scarified to depth of base. The material should be damp at time of scarifying to reduce the dust to a minimum and to aid in pulverization. If the soil contains clods, it shall be pulverized until not less than 80 percent, exclusive of gravel or stone, will pass a 4.75 mm sieve.

**311.4.2 Application of Cement:** The quantity of cement shall be by mass as a percentage of the dry mass of the soil as determined by the laboratory and/or as directed by the Engineer and shall be applied uniformly on the soil in a manner satisfactory to the Engineer. The allowable deviation in uniformity shall not exceed 10 percent. The entire operation of spreading and mixing shall be conducted in such a manner as will result in a uniform soil cement and water mixture for the full design width and depth.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform and intimate mixture of the soil and cement during mixing operations, and it shall not exceed the specified optimum moisture content for the soil cement mixture.

## SECTION 311

**311.4.3 Mixing:** Mixing with addition of water as required shall be continued until the product is uniform in color and at optimum moisture content. Any mixture of soil and cement which has not been compacted and finished shall not remain undisturbed for more than 30 minutes but shall be agitated by remixing.

**311.4.4 Optimum Moisture:** Optimum moisture requirements and field tests of moisture density shall be determined in accordance with AASHTO T-134, T-191, T-217, or ASTM D-558, D-2922, D-3017 on representative samples of soil cement mixture obtained from the area being processed. At time of laydown, the moisture content shall not be below optimum moisture, and shall be less than that quantity which will cause the base course to become unstable during the compaction and finishing process. Any area which becomes so unstable shall be removed and replaced with new cement stabilized material.

**311.4.5 Compaction:** After mixing is complete, the mixture shall be carefully placed in a uniform loose depth which will provide a surface true to grade and section when compacted. Unless otherwise directed by the Engineer, initial compaction shall be by means of a tamping, grid, or pneumatic roller. After the tamping roller has partially walked out, pneumatic rollers shall be used. Density of final product shall be not less than 95 percent as determined by AASHTO or ASTM as specified above.

**311.4.6 Finishing:** As compaction nears completion, the surface of the base course shall be shaped to required lines, grades and cross-section. When required, the surface shall be lightly scarified with spike tooth harrows or other approved equipment to remove imprints left by equipment or to prevent slippage planes. During the finishing process the surface shall be kept moist by means of fog-type sprays. Surface finish and final compaction shall be completed in not more than 2 hours from time of laydown. The completed base course shall be true to line, grade, cross-section and shall not vary more than 13 mm in thickness and not more than 25 mm in surface tolerance when tested with a 3 m straight edge. It shall be free of surface cleavage planes, cracks, or loose material. As a final operation, the surface shall be very lightly scalped with a motor grader, wet with a fog spray and rolled with a pneumatic roller as directed by the Engineer.

**311.4.7 Deficiency:** When in the opinion of the Engineer there is reason to believe that a deficiency in thickness exists, cores will be taken in the same pattern as that defined in Section 321. If the base has been covered or it is otherwise impractical to correct the deficiency, the corrective measures, listed in Table 310-1 for Type I or II deficiencies, shall be taken by the Contractor at no additional cost to the Contracting Agency.

**311.4.8 Curing:** After completion of the final finishing process, the soil-cement shall be cured with a bituminous curing seal applied at the end of each construction day. This seal may be either an emulsion or cut-back asphalt applied at a minimum rate of 0.9 L/m<sup>2</sup>. The finished soil-cement shall be kept continuously moist until the bituminous cure seal is applied, using fog or gravity bar spray. The spray equipment shall be approved by the Engineer before construction is begun.

**311.4.9 Construction Joints:** At the end of each day's work, a construction joint shall be made transverse to the centerline of the road by cutting back into the work to provide a full depth vertical joint. Except where specifically authorized by the Engineer, no other construction joints will be permitted. Where authorized, such joints shall be full depth vertical joints.

**311.4.10 Maintenance:** The Contractor shall maintain the surface until it has been covered with the designated bituminous wearing course. In case it is necessary to replace any soil cement, it shall be for the full depth. No skin patches or soil cement will be permitted. Minor surface pits may be filled with compacted bituminous surfacing, if authorized by the Engineer. Immediately prior to the placing of the bituminous wearing course, the surface shall be broomed to removed all loosened material from the surface.

### 311.5 MEASUREMENT:

Measurement of soil cement will be the number of square meters constructed to the required depth, completed and accepted.

Measurement of portland cement will be the number of tonnes of cement mixed with local soil.

## SECTION 321

Break down and compaction rolling shall be done by either steel-wheel or pneumatic-tire rollers. The Engineer may require a pneumatic-tire roller for one of the rolling operations. Rolling shall continue until the specific gravity of the compacted mixture is not less than 95 percent of the specific gravity of specimens composed of the same materials in similar proportions or composed of the same mixture compacted in the laboratory by the 75 blow method of AASHTO T-245, if the mix was designed by the Marshall method. If the mix was designed by The Asphalt Institute's SP-2 Gyratory method, rolling shall continue until the specific gravity of the compacted mixture is not less than 93 percent of the maximum theoretical specific gravity (ASTM D-2041) of specimens composed of the same materials in similar proportions or composed of the same mixture compacted in the laboratory.

Finish rolling shall be done by means of steel-wheeled roller or a vibratory steel-wheel roller operated in the static mode.

The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 6 mm from the lower edge of a 7.5 m straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the contractor and shall be acceptable of the Engineer.

All streets shall be water tested for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance, or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

**321.5.5 Preservative Seal:** An asphalt concrete preservative seal shall be used on all new asphalt concrete pavement and shall comply with Section 334. The Engineer will make a field determination and provide the actual application rate or delete the requirement. This seal is not required for pavement machine and surface replacement over pipe trenches, etc., unless specified in the special provisions.

### 321.6 CORRECTIVE REQUIREMENTS FOR DEFICIENCIES:

**321.6.1 Thickness:** When, in the opinion of the Engineer, there is reason to believe that the pavement may be deficient in thickness, cores will be taken by the Engineer at random locations, with 1 core for each 2.5 m or portion thereof of width and for every 150 m of lineal distance, with a minimum of 1 core per 2.5 m of width between intersecting streets or portions thereof. When a deficiency of more than 6 mm is found, 2 additional cores will be taken not closer than 30 m apart nor closer than 30 m to the original core, and the average of these 3 cores will be used to determine the amount of the deficiency. Further cores may be taken by the Contractor if he so chooses, to determine the limits of the deficiency, and shall be at no additional cost to the Contracting Agency but shall not be used in determining the average thickness of the pavement. Thickness of the cores shall be determined by average caliper measurement. Where pavement thickness is deficient by 6 mm or less, it will be paid for at the contract price.

Where the pavement is deficient in thickness by more than 6 mm but not more than 13 mm, payment will be reduced per Table 321-1.

<b>TABLE 321-1</b>	
<b>PAVEMENT THICKNESS PAYMENT REDUCTION (AC)</b>	
<b>Specified Mat Thickness</b>	<b>Reduction in Payment</b>
less than 40 mm	50%
40 mm to 49 mm	33%
50 mm to 59 mm	25%
60 mm to 69 mm	20%
70 mm and over	17%

**SECTION 321**

When the deficiency of the pavement thickness exceeds 13 mm, the pavement shall be overlaid on the area affected, but in no case less than one City block or 200 m whichever is less in length, for the full width of pavement, with a new mat of material specified by the Engineer, equal in thickness to the deficiency but not less than 13 mm in any instance. This is to be done at no additional cost to the Contracting Agency.

The monetary compensation shown in Table 321-1 will apply when a public agency is the Contracting Agency. When the contract is directly with a party other than a public agency, as in the case of permits, etc., the Contractor shall place an asphalt chip seal using precoated chips, complying with Section 330 when the pavement is deficient by more than 6 mm but not more than 13 mm in lieu of the monetary consideration. The area covered shall be as specified in the preceding paragraph.

When the pavement is deficient in thickness by more than 6 mm, all coring done to establish this premise shall be at the expense of the Contractor.

**321.6.2 Density:** When, in the opinion of the Engineer, there is reason to believe that the compaction of the mixture is deficient, cores will be taken in the same pattern as that defined in the first paragraph of this subsection, except that the figure 1 percent will be substituted for 6 mm, and tested for specific gravity.

Where the specific gravity is deficient by 1 percentage point or less, it will be paid for at the contract price.

Where the specific gravity is deficient by more than 1 percentage point and the Contractor is unable to correct the deficiency, payment will be reduced per Table 321-2.

<b>TABLE 321-2</b>	
<b>PAVEMENT DENSITY PAYMENT REDUCTION (AC)</b>	
<b>Deviation Below Specification</b>	<b>Reduction in Payment</b>
2% points	2%
2 to 3% points	5%
3 to 5% points	10%

When the deviation is more than 5 percentage points, the Contractor shall place a standard precoated chip seal complying with Section 330 over the area involved but for not less than one City block or 200 m whichever is less.

The monetary compensation shown in Table 321-2 will apply when a public agency is the Contracting Agency. When the contract is directly with a party other than a public agency, as in the case of permits, etc., the following applies in lieu of the monetary consideration above. When the deviation is 2% to 5% points inclusive, the Contractor shall place a asphalt chip seal using precoated chips complying with Section 330 over the area involved, but for not less than one City block or 200 m, whichever is less.

**321.6.3 Asphalt Cement Content:** When the asphalt cement content exceeds the limits established in Section 710, 2 additional core tests will be made for each deficient test taken, and the average of all 3 tests made shall be used to determine the asphalt cement content.

When the asphalt cement content is in excess of that permitted, the Contractor shall remove any areas of bleeding, but in no case less than the specified roller width, as directed by the Engineer, and replace the affected material with new material meeting the specification requirements for the mix type involved. This shall be done, any time within a period of 1 year until the bleeding has been corrected, at no additional cost to the Contracting Agency. Should the stability of the mix be affected by the excess asphalt cement to such an extent that the pavement is displaced under normal traffic loads, within a period of 1 year, the areas affected shall be removed and replaced with new material, at no additional cost to the Contracting Agency.

When the asphalt cement content is from 0.0 to 0.2 percent points, mass of the total mixed material less than the minimum permitted in Section 710, payment to the Contractor for asphalt concrete pavement will be reduced per Table 321-3.

## SECTION 505

Tunnel centering — 100 percent of the concrete load where concrete is placed by pumping. Forms shall be so constructed to provide adequate relief for excessive pump pressure.

All other structures — a live load of 1.4 kN/m<sup>2</sup> of horizontal area.

Transverse and longitudinal bracing — a horizontal force equal to 2 percent of the vertical load.

The unit stresses for wood falsework shall be those recommended in the West Coast Lumbermen's Association's standard grading and dressing rules increased 25 percent for short time loading.

Falsework may be bolted or spiked at the option of the Contractor, but the use of bolts and spikes shall not be combined in the same connection. The allowable spacings and connection values of bolts and spikes shall be in accordance with the national design specifications for stress-grade lumber and its fastenings as recommended by National Lumber Manufacturers Association except that an additional allowance of 25 percent for temporary use shall be added to the connection values for bolts and spikes.

Ends of columns bearing on wedges shall be tied in both direction by girts.

Unit stresses for steel falsework shall be in accordance with the requirements of the specifications for design, fabrication and erection of structural steel for buildings of the AISC.

### 505.5 PLACING REINFORCEMENT:

Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position by wiring at intersections with wire not smaller than 1.58 mm and by using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Wooden supports shall not be used.

Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing in the forms, all reinforcing steel shall be thoroughly cleaned of mortar, oil, dirt, loose mill scale, loose or thick rust and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

Bundle bars shall be tied together at not more than 1.8 m centers.

**505.5.1 Splicing:** Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced they shall be lapped at least 30 diameters, unless otherwise shown on the plans.

Welding of reinforcing steel will not be permitted unless specifically authorized by the Engineer.

**505.5.2 Bending Reinforcement:** Bends and hooks in bars shall be made in the manner prescribed in the ACI, Manual of Standard Practice.

Bars shall not be bent nor straightened in a manner that will injure the material. Bars with kinks or unspecified bends shall not be used.

**505.5.3 Welded Wire Fabric:** Welded wire fabric shall be held firmly in place and spliced not less than 2 meshes.

### 505.6 PLACING CONCRETE:

Where a schedule for placing concrete is shown on the plans, no deviation will be permitted therefrom unless approved in writing by the Engineer.

The placing of concrete for a given pour shall start at the low point and shall proceed upgrade, unless otherwise permitted by the Engineer.

## SECTION 505

With the exception of concrete placed in slope paving and aprons, and concrete placed under water, all concrete shall be compacted by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The number of vibrators employed shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least 2 vibrators shall be available at the site of the structure in which more than 20 m<sup>3</sup> of concrete is to be placed. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The locations, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Fresh concrete shall be spread in horizontal layers insofar as practicable and the thickness of the layers shall not be greater than can be satisfactorily consolidated with the vibrators. If additional concrete is to be placed, care shall be taken to remove all laitance and to roughen the surfaces of the concrete to insure that fresh concrete is deposited upon sound concrete surfaces. Layers of concrete shall not be tapered off in wedge-shaped slopes, but shall be built with square ends and level tops.

Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

Fresh concrete shall not be permitted to fall from a height greater than 1.8 m without the use of adjustable length pipes or elephant trunks.

The use of approved external vibrators for compacting concrete will be permitted when the concrete is inaccessible for adequate compaction provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

During the placing of concrete, care shall be taken that methods of compaction used will result in a surface of even texture free from voids, water or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface. Spades or broad-tined forks shall be provided and used to produce the desired results if required by the Engineer.

The use of chutes in conveying or depositing concrete will be allowed only at the discretion of the Engineer, and wherever they are used they shall be laid at such inclination as will permit the flow of concrete of such consistency as is required. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed. Where necessary in order to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

Columns shall be poured preferably through pipes of adjustable length and not less than 150 mm in diameter.

Horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections has been consolidated and a minimum 2 hour period has elapsed to permit shrinkage to occur.

Walkways shall be provided along each side and for the full length of bridge structures outside the deck area. These walkways shall be of sufficient width, and so constructed as to provide for the support of the bridges from which the longitudinal floats specified are to be operated. Inspection walkways and access thereto shall be provided under the deck forms between each pair of girders and outside of each outside girder for the full length of the bridge structure. The walkways shall be not more than 2.4 m below the concrete to be inspected.

**505.6.1 Joints:** The work shall be so prosecuted that construction joints will occur at designated places shown on plans unless specifically permitted otherwise by the Engineer. The Contractor shall complete, by continuous depositing of concrete, section for the work comprised between such joints. The joints shall be kept moist until adjacent concrete is placed.

All construction joints at the bottom of walls or arches, at the top of walls, and all longitudinal construction joints having a keyed, stepped or roughened surface shall be cleaned by sandblasting prior to pouring the adjacent concrete. Any quality of sand may be used which will accomplish the desired results.

The sandblasting operations shall be continued until all unsatisfactory concrete, and all laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed thoroughly to remove all loose material. The method used in disposing of waste water employed in washing the concrete surfaces shall be such that the waste water will not stain, discolor, or affect exposed surfaces of the structures. The method of disposal will be subject to the approval of the Engineer.

All horizontal construction joints or those on slight slopes, shall be covered with Class D mortar as specified in Section 776.

## **SECTION 530**

### **PAINTING**

#### **530.1 DESCRIPTION:**

This work shall consist of furnishing paint and other necessary materials and painting metal, wood or other surfaces in accordance with the details shown on the plans and these specifications.

#### **530.2 MATERIALS:**

Materials used in paint for painting shall conform to the requirements of Section 790.

#### **530.3 WEATHER CONDITIONS:**

Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather. Except as provided below, painting will not be permitted when weather conditions during application are such that the atmospheric temperature will drop below 2EC during the drying period. If fresh paint is damaged by the elements, it shall be replaced by the Contractor at no additional cost to the Contracting Agency.

Subject to the approval of the Engineer, the Contractor may provide suitable enclosures to permit painting during inclement weather. Provisions must be made to control atmospheric conditions artificially inside the enclosures within limits suitable for painting throughout the painting operation. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

#### **530.4 APPLICATION:**

Painting shall be done in a neat and workmanlike manner. Unless otherwise specified paint shall be applied either by brush, roller, or spray methods.

If brushes are used, they shall have sufficient body and length of bristle to spread the paint in a uniform coat. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes. Paint shall be evenly spread and thoroughly brushed out. If a considerable amount of brush marks appear, it will be considered that the paint has been improperly applied. If rollers are used, they shall be of a type that do not leave a stippled texture in the paint file.

On all surfaces which are inaccessible for brushing, the paint shall be applied by spray or by sheepskin daubers especially constructed for the purpose, or by other means approved by the Engineer.

If spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory and the Contractor may be required to apply the remainder of the paint by brush.

A water trap acceptable to the Engineer shall be furnished and installed on all equipment used in spray painting.

Mechanical mixers shall be used to mix the paint. The paint shall be mixed a sufficient length of time, prior to use, to thoroughly mix the pigment and vehicle together. Paint shall be kept thoroughly mixed while being applied.

#### **530.5 THINNING PAINT:**

Paints specified are formulated ready for application and no thinning will be allowed. If the paint becomes thick in cool weather, it shall be heated in the container immersed in hot water.

#### **530.6 PROTECTION OF WORK:**

The Contractor shall protect all parts of the structure against disfigurement by spatters, splashes, and smirches of paint or of paint materials. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property, and shall provide protective means to guard against such damage at his expense.

## SECTION 530

Paint stains which might result in an unsightly appearance shall be removed or obliterated by the Contractor.

When ordered by the Engineer, if traffic causes an objectionable amount of dust, the Contractor shall sprinkle the adjacent roadbed and shoulders with water for a distance on each side of the location where painting is being done sufficient to abate the dust nuisance. The Contractor shall furnish and post at his own expense DRIVE SLOWLY signs and take other necessary precautions to prevent dust and dirt from accumulating on freshly painting surfaces.

### 530.7 SAFETY PRECAUTIONS:

The following safety precautions shall be observed in addition to those prescribed by law in Section 107.

The applicable sections of NACE, A Manual for Painter Safety.

### 530.8 SURFACE PREPARATION FOR PAINTING:

**530.8.1 Steel:** Surface preparation for painting of the steel shall conform to the surface preparation specifications of the Steel Structures Painting Council.

Unless otherwise specified, the commercial blast method shall be used.

After erection and riveting or welding, all surfaces of structural steel which will be exposed to air in the completed structure and the repainting of existing steel structures where partial painting is required, the method of cleaning will be as directed by the Engineer or as specified in the special provisions.

#### 530.8.2 Galvanized Surfaces:

(A) Hand Cleaning: Concrete spatter, heavy grease, and other foreign matter shall be removed from galvanized surfaces by hand scraping or wire brushing.

(B) Solvent Cleaning: After hand cleaning, all galvanized surfaces shall be cleaned by the solvent cleaning procedures prescribed in Section 530.8.1 above to remove oil, grease and other detrimental foreign matter.

(C) Pretreatment: After hand and solvent cleaning, the cleaned areas shall then be painted by brushing on at least 1 full coat of paint No. 1. Unless otherwise directed by the Engineer, the second coat shall be applied within 24 hours after the primer is applied.

**530.8.3 Wood Surface:** Wood surfaces shall be prepared for painting by removing all cracked or peeled paint, loose chalky paint, dirt, and other foreign matter by wire brushing, scraping, sanding, or other approved means immediately prior to painting. All surfaces shall be wiped or dry brushed to remove any dust or chalky residue that may result from cleaning operations. All wood designated to be painted shall be thoroughly dry before paint is applied.

### 530.9 PAINTING:

#### 530.9.1 Structural Steel:

(A) Paint: Unless otherwise required on the plans or in the special provisions, the paints to be applied to structural steel surfaces shall consist of a shop prime coat, as specified in Section 515, a second coat, and a finish coat. The total dry film thickness of the prime and second coat shall be not less than 0.08 mm. The dry thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge.

Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

Unless specified otherwise on the plans or in the special provisions, the paint coats shall be as specified for general use on structural steel in Section 790. Succeeding coats of paint, not otherwise materially different in color, shall have carbon black mixed into the paint in accordance with Section 790 to produce a perceptible color difference between the paint coat being applied and the preceding coat.

## SECTION 603

### INSTALLATION FOR HIGH DENSITY POLYETHYLENE PIPE

#### 603.1 DESCRIPTION:

The work covered by this specification consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with a large-diameter High Density Polyethylene (HDPE) pipe installation in accordance with the plans, specifications and special provisions.

For installation procedures of HDPE for sewer line construction, see Section 615.

For installation procedures of HDPE for storm drain construction, see Section 618.

HDPE pipe and fittings shall conform to Section 738.

This section covers large-diameter HDPE pipeline installations of gravity and low-pressure storm drain and sanitary sewer construction.

For the purposes of this specification, low-pressure is defined as 7.6 m of water column or less.

For the purpose of this specification, large-diameter HDPE pipe shall include 200 mm to 3000 mm nominal diameter.

#### 603.2 EXCAVATION:

Excavation shall comply with Subsection 601.2, except for Trench widths (601.2.2). The width of the trench will be designed by the Engineer and included on the plans or in the special provisions.

#### 603.3 PROTECTION OF EXISTING UTILITIES:

Protection of existing utilities shall comply with Subsection 601.3.

#### 603.4 FOUNDATION, BEDDING, BACKFILLING AND COMPACTION:

**603.4.1 Foundation:** Foundation shall comply with Subsection 601.4.1.

**603.4.2 Bedding:** Coarse aggregate shall be used for bedding of large-diameter profile HDPE pipe. Coarse aggregate shall be in accordance with Subsection 603.4.6, for size, type, and gradation. For corrugated HDPE pipe as defined under Section 738, bedding shall meet the requirements of subsection 601.4.2 and Table 601-2 with the compaction requirements stipulated below.

Bedding material shall be carefully deposited in 200 mm or less loose lifts, thoroughly and carefully compacted around the pipe, equally around both sides of the pipe, with approved vibratory compactors or other tools or equipment when applicable, or by shovel slicing as approved by the Engineer. This shall be repeated until enough material is placed and compacted to provide a minimum of one 300 mm cover over the top of profile HDPE pipe, or to the top of corrugated HDPE pipe. Compaction densities, as well as further compaction requirements shall be as stipulated in Table 601-2, unless shown otherwise on the plans.

**603.4.3 Backfilling:** Backfilling shall comply with Subsection 601.4.3.

**603.4.4 Compaction Densities:** Compaction densities shall comply with Subsection 601.4.4.

**603.4.5 Compaction Methods:** For large-diameter HDPE pipe installations where the backfill and bedding material is coarse aggregate, mechanical compaction shall be the only method for consolidating backfill and bedding. Water consolidation shall not be used as a method of compaction for coarse aggregate whether used as a foundation, bedding or backfill material.

For large-diameter pipe installations where the backfill material is other than coarse aggregate, consolidation shall be by mechanical means. Water consolidation may be used as a compaction method for the backfill material only when prior written approval to do so is provided by the Engineer.

## SECTION 603

**603.4.6 Specifications for Material:** Coarse aggregate shall consist of crushed rock as defined in Section 701 with 100 percent of the specified size of aggregate having one fractured face, and having the gradation complying with ASTM D-448, Table 1, Size Numbers 6, 67, 68, 7, 78, or 8 as recommended by the Engineer. The gradation size number to be furnished shall be shown on the plans or in the project specifications.

**603.4.7 Rights-of-Way Belonging to Others:** Rights-of-way belonging to others shall comply with Subsection 601.4.7.

**603.4.8 Test Holes:** Test holes shall comply with Subsection 601.4.8.

**603.4.9 Foundation and Bedding for Electronic, Telephonic, Telegraphic, Electric, Oil and Gas Lines:** Foundation and bedding for electronic, telephonic, telegraphic, electric, oil and gas lines shall comply with Subsection 601.4.9.

### 603.5 PREPARING AND INSTALLING HDPE PIPE:

**603.5.1 Storage and Handling:** Pipe shall be stored and handled in such a way to minimize out-of-roundness. Pipe shall be stored in shaded areas to minimize adverse effects of thermal, and ultraviolet exposure.

Pipe that is out-of-round in excess of 3% of the nominal pipe diameter as specified in Section 738, shall not be installed and shall be removed if installed.

**603.5.2 Strutting:** Strutting of Profile HDPE pipe per Section 738 will be required when the diameter is 1 m or larger. For Profile HDPE pipe with diameters smaller than 1 m, strutting may be required at the discretion of the Engineer. Strutting of Corrugated HDPE pipe per Section 738 is not required.

Strutting consists of placing wood struts, whose length is typically 3% longer than the nominal pipe diameter, inside the pipe. A minimum of three (3) sets of struts are placed in each pipe length, oriented vertically, spaced equally throughout the length of pipe and set so as not to interfere with the jointing of the pipe. The struts shall be kept in place until the bedding material is placed and compacted around the pipe. The struts must be removed before any backfill or bedding is placed above the pipe. The procedure of strutting the pipe shall not damage the pipe in any way. If the pipe is out of round, the struts will be placed in the long direction of the out-of-round. If the strut cannot be held in place by the pipe, the pipe will be removed from the job site per Subsection 738.9.

**603.5.3 Orienting:** If the pipe is out-of-round, the pipe should be oriented so that the long axis is placed vertically when installed in the trench. When struts are used, the struts shall be oriented vertically when pipe is installed in the trench.

**603.5.4 Installing Pipe:** HDPE pipe and fittings shall be installed in accordance with ASTM D-2321 or manufacturer's recommendation. HDPE pipe shall be handled so as not to damage the pipe. Hoisting shall be accomplished with cloth belt slings or ropes. The pipe shall be protected by wood blocking when jointing is accomplished by pipe jacking, back hoe bucket, come-along, or cable pipe puller.

**603.5.5 Affidavit of Installation:** The Contractor's methods and procedures for installing HDPE will be reviewed in the field by the pipe manufacturer or his designated representative. The Contractor will make any adjustments in the installation as recommended by the manufacturer or his representative. If necessary, the Contractor may be required to reinstall or provide corrections to pipe installed prior to the field review. The manufacturer or his representative shall furnish to the Contracting Agency an affidavit (certification) that the Contractor's installation methods and procedures comply with the manufacturer's installation practices.

### 603.6 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:

Pavement replacement and surface restoration shall comply with Subsection 601.5.

### 603.7 PAYMENT:

No pay item will be included in the proposal, nor direct payment made for trench excavation, backfilling, compaction, or placement of temporary pavement. The cost of these features of work shall be included in the unit price for furnishing and laying pipe.

End of Section

## SECTION 604

### PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

#### 604.1 DESCRIPTION:

The work covered by this specification consists of furnishing all materials, labor and equipment for the placement of controlled low strength material (CLSM).

The following is a brief description of the types of controlled low strength material (CLSM) and their intended uses:

- ½ SACK: One half sack CLSM can be used as a general trench backfill in areas where future excavation into the backfill is anticipated or in areas of low loading such as streets, parking areas, behind retaining walls, etc.
- 1 SACK: One sack CLSM can be used as a general trench backfill and backfill behind retaining walls where additional strength is required above that of ½ sack CLSM.
- 1 ½ SACK: One and one half sack CLSM can be used as a structural backfill under foundations and as thermal fill and/or mechanical protection of duct banks and conduits.

The type of backfill to be used shall be as specified in the special provisions, plans or by the Engineer.

#### 604.2 MATERIALS:

Controlled low strength material shall conform to the requirements of Section 728.

#### 604.3 PLACEMENT:

The controlled low strength material shall be placed directly into the excavation. The CLSM shall be placed in a uniform manner that will prevent voids in or segregation of the material. Foreign material which falls into the trench prior to and during placing of the CLSM shall be immediately removed. The CLSM shall have consistency, workability, plasticity, flow characteristics and pumpability (when required) such that the material when placed is self-compacting. Mechanical compaction or vibration may be used to consolidate around structures, pipes, multiple conduits, etc., otherwise no mechanical compaction or vibration shall be required.

When CLSM is used for backfill around pipes or conduits, the CLSM shall be placed equally on both sides of pipe or conduit to prevent lateral displacement. Also, the CLSM shall be placed in lifts. The height of each lift shall not exceed the depth that will cause floating of the pipe or conduit. When placing the CLSM in greater lift depths, sufficient anchorage shall be provided so the pipe or conduit will not float.

Where CLSM is used for backfill around pipes or conduits with a depth less than 6 m, the width of the excavation shown on the plans or in Section 601 may be reduced so that the minimum clear distance between the outside of the pipe or conduit and the side of the excavation (each side) shall be 300 mm for pipes or conduits 1065 mm and larger, 150 mm for pipes or conduits between 100 mm and 1065 mm and 75 mm for pipes or conduits 100 mm and smaller.

When CLSM is used behind retaining walls, the depth of each lift shall be limited so it will not induce hydraulic loads greater than the design loads.

For long trenches or installations which require a large amount of CLSM, bulkheads of wood, dirt, sand bags, etc. can be used to control the material's flowability. The bulkhead shall be removed prior to the continuation the backfilling.

CLSM shall NOT be permitted to come in contact with any aluminum, copper or brass materials, e.g., aluminum pipes or culverts, copper water pipe, saddles, fittings, etc. Protection shall be any combination of the following: place a layer of noncorrosive material around the pipe e.g., native material, import material, etc. or provide a protective covering or wrapping such as polyethylene wrap per Section 610.5. Pipes smaller than 100 mm can be completely wrapped with tape as per Section 610.5 or approved equal.

Generally, CLSM does not resist freezing and thawing and in some cases may propagate the condition. Further testing may be required prior to placing the material in a freeze-thaw condition.

## SECTION 604

### 604.4 PROTECTION:

When CLSM is placed within the traveled way or otherwise to be covered by paving or embankment materials, the material shall achieve a penetration resistance of 76 mm (indentation diameter) or less with 5 drops at a drop distance of 127 mm prior to covering and opening to traffic or the installation of the surface be delayed for 12 hours, which ever occurs first. Penetration resistance shall be as measured by ASTM Test Method D-6024, "Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application."

When CLSM is placed in foundation excavations, the material shall be protected from foundation loading and placement of foundation concrete prior to having reached initial set per ASTM C-403, or allowed to set in place for 24 hours, whichever occurs first.

Where the Engineer has identified soils as being moisture sensitive, a drainage notch or drain wick shall be placed longitudinally along the centerline of the trench or CLSM placement. The notch or wick shall be constructed within the first hour following placement. Drainage water shall be collected and removed at the end of notch or wick.

### 604.5 ACCEPTANCE:

CLSM shall be considered deficient and may be rejected at the discretion of the Engineer if:

- (A) The CLSM is outside of the limits specified in Table 728-1 and/or
- (B) The aggregate gradation is outside the limits specified in Section 701.3.5.

Rejected material not placed shall be immediately removed from the job site. Rejected material placed shall be removed and replaced with acceptable material. Removing and disposing of the rejected material shall be at no additional cost to the Contracting Agency.

### 604.6 PAYMENT:

No pay item will be included in the proposal nor direct payment made for CLSM. The cost for placing the material shall be included in the unit price bid for the specific work function (laying pipe, placing structure foundation, construction retaining wall, etc.).

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End of Section

## SECTION 610

(2) Payment will be made at the unit price bid for each unit water meter service connection and shall be compensation in full for labor materials (other than pipe) equipment, tapping, and all necessary incidentals. Payment for new service pipe required to make the connection will be made separately, as stipulated above.

(C) Relocation of Existing Meters and Boxes: Measurement shall be of the number of meters and boxes moved and reinstalled. Payment will be made at the unit price bid in the proposal for each meter and box relocated and installed.

(D) Permanent Pipe Supports and Encasement of Existing Pipes: Measurement shall be of each unit included in the proposal, and payment shall be compensation in full for supporting or encasing existing pipe, as required on the plans, including excavation, form work, reinforcing, concrete, handling and controlling flows in the existing pipe, removing and replacing existing pipe where necessary, supporting, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section 336.

(E) Concrete Thrust Blocks: Concrete thrust blocks and anchors for all pipe 400 mm and larger shall be measured by the cubic meter(s) of concrete placed, as required on the plans and/or as directed by the Engineer. Payment will be made at the unit price bid per cubic meter, and shall be compensation in full for excavation, formwork, placing and finishing concrete, reinforcing, backfilling and compaction, and pavement and/or surfacing replacement required in excess of pay width(s) allowed in Section 336. All thrust blocks and anchors for 300 mm and smaller pipe shall be included in the linear meter cost of the pipe.

(F) Valves: Measurement of and payment for valves, tapping sleeves and valves, and valve boxes shall be for each item furnished and installed, as designated in Section 630.

(G) Fire Hydrants: Measurement shall be the number of fire hydrants installed. Payment will be at the unit price bid for the installation of each fire hydrant complete in place and in operating condition. The 150 mm cast iron pipe and fittings, required for making the connection from the main to the hydrant, shall be a separate pay item in the proposal as described above.

(H) Pavement and/or Surfacing Replacement: Payment for pavement and/or surfacing replacement will be made as stipulated in Section 336, except as otherwise established in this specification. The cost of pavement and/or surface replacement required for meter service installations shall be included in the price bid for meter service pipe.

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End of Section

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## SECTION 611

### DISINFECTING WATER MAINS

#### 611.1 CLEANING AND TREATING PIPE:

The interior of all pipe and fittings shall be kept as free as possible of all dirt and foreign material at all times, until the pipe is placed in the new line.

If in the opinion of the Engineer, the pipe contains dirt that will not be removed during the flushing operation, the interior of the pipe shall be cleaned and swabbed, as necessary, with a .005 to .010 percent chlorine solution.

#### 611.2 LAYING PIPE:

If the Contractor or pipe-laying crew cannot install the pipe in the trench without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size be placed over each end of the pipe and left there until the connection is to be made to the adjacent pipe.

At the close of each day's work, the end of the last laid section of pipe shall be plugged, capped, or otherwise tightly closed to prevent the entry of foreign material of any nature.

#### 611.3 PREVENTING TRENCH WATER FROM ENTERING PIPE:

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. Joints of all pipe in the trench shall be completed before the work is stopped. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

#### 611.4 PACKING MATERIAL:

Only such packing materials as are included in the list of acceptable materials in AWWA C-600 for installation of cast iron water main, shall be used. The packing materials shall be handled in such a manner as to avoid contamination, and shall be dry when placed in the joints. All such materials shall be free of oil, tar, or greasy substances, except that treated paper packing material, jute, cement, or sulphur compound caulking will not be permitted.

#### 611.5 FLUSHING COMPLETED PIPE LINES:

(A) Preliminary Flushing: All mains 300 mm and smaller shall be flushed, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. It is difficult to flush mains over 300 mm in diameter, so in such instances the requirements above, must be rigidly adhered to.

Heavy duty, factory bushed, tapped couplings, with corporation stops shall be located at all high points in the lines to allow the air to be removed prior to testing the water lines and at disinfection points as may be required. Field taps will not be permitted.

The couplings, at high points and disinfection points, shall be left exposed during backfilling until the testing is complete. Couplings and corporation stops shall be left on the mains upon completion of water mains.

(B) Valve Damage by Foreign Material: Unless proper care and thorough inspection are practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid or repaired. If it is believed that such foreign material(s) may be in the main, all hydrants on the line shall be thoroughly flushed and carefully inspected after flushing to see that the entire valve operating mechanism of each hydrant is in good condition.

#### 611.6 CHLORINE RESIDUAL:

Before being placed in service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe.

## SECTION 611

### 611.7 METHODS OF APPLYING CHLORINE:

Any of the following methods of application of chlorine (arranged in order of preference) may be used, subject to the approval of the Engineer.

Liquid chlorine gas-water mixture.

Direct chlorine feed.

Calcium or sodium hypochlorite and water mixture.

### 611.8 APPLICATION OF LIQUID CHLORINE:

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device or, if approved by the Engineer, the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas or of the gas itself must provide means for preventing the backflow of water into the cylinder.

### 611.9 CHLORINE-BEARING COMPOUNDS IN WATER:

On approval of the Engineer, a mixture of water and a chlorine-bearing compound of known chlorine content may be substituted for liquid chlorine.

(A) Compounds to be Used: The chlorine-bearing compounds that may be used are: Calcium hypochlorite\*, and sodium hypochlorite\*\*.

(B) Preparation of Mixture: High-test calcium hypochlorite must be prepared as a water mixture for introduction into the water mains. The powder should first be made into a paste and then thinned to approximately a 1 percent chlorine solution (10,000 ppm). The preparation of a 1 percent chlorine solution requires the following proportions of powder to water:

Product	Amount of Compound	Quantity of Water (Liters)
High-test calcium hypochlorite (65—70% Cl)	0.45 kg	28
Liquid laundry bleach (5.25% Cl)	0.5 - 1 liter	48

### 611.10 POINT OF APPLICATION:

The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it and through a corporation stop inserted in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipe line extension.

### 611.11 RATE OF APPLICATION:

Water from the existing distribution system or other source of supply shall be controlled so the rate of flow shall not exceed 32 liters per second, unless approved by the Superintendent of Water Distribution, through a suitable measuring device into the newly laid pipe line during the application of chlorine. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least 10 ppm of residual chlorine after 24 hours standing in the pipe. This may be expected with an application of 50 ppm, although some conditions may require more.

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\*Comparable to commercial products known as HTH, Perchloron, and Pittchlor.

\*\*Known commercially as liquid laundry bleach.

## SECTION 611

On lines 300 mm in diameter or less, determination of the rate of flow of water into the line to be treated may be made by starting with the line full of water and measuring the rate of discharge at a hydrant located at the end of the pipe farthest away from the point of chlorine application.

For lines larger than 300 mm in diameter, the disinfection operation is generally started with the line empty.

Measurement of the flow of water into and out of all lines shall be made by means of a pilot gage, current type meter, or other approved device.

### **611.12 PREVENTING REVERSE FLOW:**

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves shall be used to accomplish this.

### **611.13 RETENTION PERIOD:**

Treated water shall be retained in the pipe long enough to destroy all nonspore-forming bacteria. This period should be at least 24 hours and should produce no less than 10 ppm residual chlorine at the extreme end of the line at the end of the retention period.

NOTE: If the circumstances are such that less than a 24 hour retention period must be used, the chlorine concentration shall be increased to 100 ppm. Under these conditions, special care should be taken to avoid attack on pipes, valves, hydrants and other appurtenances.

### **611.14 CHLORINATING VALVES AND HYDRANTS:**

In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

### **611.15 FINAL FLUSHING, SAMPLING AND TESTING:**

Following chlorination, all treated water in the newly laid pipeline shall be thoroughly flushed until the replacement water throughout the new pipeline can be proved, by laboratory testing, comparable in quality to the water served to the public from the existing water system. Prior to sampling for laboratory testing, the residual chlorine throughout the length of the pipeline shall be reduced to 1.0 ppm or less. Once the required residual chlorine level in the pipeline is achieved, samples shall be taken as outlined below.

The Contracting Agency or its authorized representative will collect all samples for testing of the new water mains. To initiate the sampling and testing, the Contractor will present to the Contracting Agency a written request for such work no later than 24 hours prior to the time when samples are to be taken.

Samples shall be taken from a tap and riser located and installed in such a way as to prevent outside contamination. Samples shall never be taken from an unsterilized hose or fire hydrant, because such samples will seldom meet bacteriological standards. The number of sampling locations shall be as follows: Waterlines up to but less than 45 m in length require one sampling riser installed as near the end as possible; lines 45 m to 90 m in length, two sampling risers, one near each end of the line; lines 90 m to 900 m in length, a minimum of three sampling risers. In addition, dead ends on main lines should be represented with a sampling riser.

The number of samples taken at each sampling location shall be determined by the Contracting Agency based on one of the following methods.

- a. One sample from each sampling location which is examined and analyzed in the laboratory over a three day (72 hour) period.

## SECTION 625

brick manholes shall be plastered outside with 13 mm of cement mortar as shown on the standard details. Inside of brick wall shall be neatly pointed. The plaster coat shall be cured with a liquid membrane-forming compound conforming with Section 726 immediately after plaster has been placed and finished.

**Frame and Cover.** All machined surfaces on the frame and cover shall be such that the cover will lie flat in any position in the frame and have a uniform bearing through its entire circumference. Any frame and cover which creates any noise when passed over by automobiles shall be replaced. Frames shall be set firmly in a bed of mortar true to line and grade, all as shown on the plans and as called for in these specifications.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section 601.

**625.3.2 Drop Sewer Connections:** Drop sewer connections shall be constructed in conformance with standard details, as the case may be.

Backfilling shall be done in accordance with the requirements for trench backfilling as stated in Section 601.

### **625.4 MEASUREMENT:**

Measurement will be per manhole installed, complete in place, regardless of depth.

### **625.5 PAYMENT:**

Payment will be made at the unit price bid each manhole, and shall be compensation in full for furnishing and installing manhole, complete, with formed invert, concrete foundation, ladder rungs, cast iron frame and cover, excavation and backfill, paving cut replacement in excess of the applicable pay widths authorized in Section 336, and any incidentals thereto, in conformance with the plans and specifications.

Payment will be made at the unit price bid each, and shall be compensation in full for furnishing and installing vitrified clay pipe sanitary sewer drop connections, concrete encasement, excavation, backfilling, water settling, compaction, sheeting and bracing, removal of obstructions, paving cut replacement, in excess of the applicable pay widths authorized in Section 336, testing, and all work incidental thereto in conformance with the plans and specifications.

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End of Section

## SECTION 630

### TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES

#### 630.1 DESCRIPTION:

The installation of all tapping sleeves, valves and valve boxes shall conform to this specification and standard details, except as otherwise required on the plans or as modified in the special provisions.

#### 630.2 GENERAL:

For valves 300 mm and smaller, the Contractor shall furnish the manufacturer's standard data and catalogues for gate valves, tapping valves, tapping sleeves, curb stop valves, butterfly valves and any castings.

For valves larger than 300 mm, the Contractor shall furnish shop drawings and technical data required for evaluating and approval of each type of valve, tapping sleeve and valve and butterfly valve. This information shall include complete details, dimensions, weights, diameter of stems, alloy for all valve parts, and any information that may be required to assemble, install, operate and maintain the valve.

The name of the manufacturer, the year of manufacture, the size of the valve, model number and rated working pressure, shall be cast on the body of each valve.

The Contracting Agency may test 10 percent of each type and size of valve furnished. Failure of any of the valves tested to meet these specifications, shall be deemed sufficient cause to reject the entire lot delivered.

The internal working parts of valves of the same make, type, and size, shall be interchangeable.

#### 630.3 GATE VALVES:

**630.3.1 General:** All valves shall conform to the latest revisions of AWWA standards supplemented as follows:

Valves shall be of the non-rising stem type and shall be counter-clockwise opening (left-hand).

The valve may be furnished with valve stems made from 300 or 400 series stainless steel.

Unless otherwise noted, valves shall have a 50 mm square operating nut.

All valves shall be class 150 or higher as necessary to withstand the requirements of the pressure and leakage test.

Bronze for all interior parts of valves shall contain not more than 6 percent zinc if made from cast bronze, or must conform to Copper Development Association #67600 if made from bar stock material.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 0.15 mm. Epoxy coatings shall be factory applied by a electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specifications TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

By-pass valves, valves attached to side outlets and valves in blow-off lines shall be flanged.

Valves in air release and vacuum relief lines shall be flanged or screwed as shown on the plans.

Valves in fire hydrant lines shall have a flanged joint end on the side towards the main and a restraint or mechanical joint end on the side towards the hydrant.

Valves larger than 500 mm shall have flanged ends, unless otherwise noted.

## SECTION 630

This specification generally describes valves and operator assemblies designed for underground service, as manufactured by Dresser Industries, B-I-F Industries Incorporated, Henry Pratt Company, Allis Chalmers Manufacturing Company, or approved equal.

Where material or equipment is designated on the plans or in this specification by a trade or manufacturer's name, it is so designated primarily to establish standards of quality, finish, appearance and performance.

All specific requirements of this specification must be adhered to, and all necessary modifications shall be made in the article specified by the trade name, type or model or manufacturer's equipment to make it conform to all specific requirements of this specification.

The valves shall be in accordance with AWWA C-504, Class 150-B, except as modified herein:

- (1) Valve ends may be the thin type or wafer type to be installed between flanges drilled in conformance with ASA B 16.1-125 or may be flanged both ends or the valves may have bell ends with rubber gaskets, for cast iron pipe or asbestos cement pipe conforming to the kind of pipe being used.
- (2) Valves shall be designed for buried service with the valve shaft in a horizontal position and the operating shaft vertical.
- (3) Valves shall be left-hand opening, counter-clockwise unless shown otherwise on the plans.
- (4) Discs shall be Ni-Resist, ASTM A-436, Type 1, or cast iron, ASTM A-48, Class 40, in accordance with the following variations:
  - (a) Cast iron disc may be used providing the rubber seat ring is contained on the disc with the rubber ring closing against a Type 304 stainless steel ring or a bronze ring contained in the body of the valve.
  - (b) Ni-Resist disc may be used where rubber seat is contained in the valve body.
  - (c) Valves with rubber seats in the valve body may have cast iron discs with a Type 304 stainless steel or bronze edge seating surface retained on the edge of the disc.

Shafts and disc shaft fasteners shall be constructed of Type 304, stainless steel, unless the shaft is completely sealed from the line fluid. Valve shafts completely sealed from the line fluid may be of high strength steel with all other metal parts in contact with the line fluid to be Type 304 stainless steel.

Valves with rubber seat mounted in the body shall have the rubber either bonded or mechanically retained in its final position. Rubber seats which are on the disc edge shall be retained by a clamping ring and screws. Clamping ring and screws shall be made of 18-8 stainless steel, Type 304, or bronze conforming to ASTM B-61 or ASTM B-584.

Manual operators shall have AWWA 50 mm square operating nuts and shall require at least 2 turns per 25 mm diameter to rotate the disc 90 degrees. Operators must accept a minimum of 407 joules input torque on stops at ends of travel without damage to valve or operator. The operator torque rating shall equal, or exceed, the valves shown in Table I of AWWA C-504 for valve class specified above.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 0.15 mm.

Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions.

The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements AWWA C550-81, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with 2 coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

## SECTION 630

### 630.6 AIR RELEASE AND VACUUM VALVES:

Valve assemblies shall be furnished and installed where shown and as detailed on the drawings.

(A) Air release on water mains shall be controlled by the use of an air release valve assembly, or size and type as shown on the plans. Air release valves shall be of the flanged or screwed type as shown and shall be similar and equal to Apco, Crispin or Simplex.

(B) Vacuum and Air Relief when called for on the plans shall be controlled by a vacuum relief valve on the air release valve noted above and the valves shall be of the same manufacture or may be a combination air and vacuum valve assembly similar and equal to Apco, Crispin or Simplex.

### 630.7 CONSTRUCTION METHODS:

All valves, their supports, manholes, vaults, and valve boxes shall be installed in accordance with Section 610.

Valves 400 mm and larger, before being shipped from the factory, shall have the flanged ends completely covered with plywood. Plywood shall be left on the valve until just before installation in the line.

### 630.8 MEASUREMENT:

Measurement will be by the unit each of the various kinds and sizes of valves, manholes, vaults, or tapping sleeves and valves, including valve boxes and covers.

### 630.9 PAYMENT:

Payment will be made at the unit price bid each and shall be compensation in full for the complete installation in place including all labor, materials, equipment, and all incidentals necessary to complete the installation. The compensation will also include the cost of necessary pavement replacement in excess of the pay widths allowed in Section 336 for pavement replacement over pipe trenches.

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End of Section

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## SECTION 631

### WATER TAPS AND METER SERVICE CONNECTIONS

#### 631.1 DESCRIPTION:

This specification covers work by Contractors installing water services in new subdivisions by Permit and in projects under Contract. All the materials used shall comply with applicable standard specifications and the work performed in accordance with these specifications and standard details. The service connections shall be complete and all material shall be furnished by the Contractor except for the water meter.

All water service connections shall be constructed of Type K copper tubing or ultra high molecular weight polyethylene pipe of nominal iron pipe outside diameter.

All new subdivision water lines shall be staked for line and grade at 30 m intervals by the Developer's Engineer prior to construction. All meter locations shall be staked by setting two stakes for line and marking one of the stakes for grade.

#### 631.2 MATERIALS:

Copper pipe, tubing and fittings shall conform with Section 754. Polyethylene pipe shall conform with Section 755.

All fittings, pipe and tubing for polyethylene and copper pipe shall be as noted on standard details.

#### 631.3 INSTALLATIONS:

**631.3.1 General:** Installation of copper tubing for meter service connections shall be in accordance with Section 754.

Meter service connection with copper tubing shall be in accordance with standard details.

The water service connection shall include the tap on the main, the corporation stop, the saddle if applicable, service pipe, appurtenant fittings, the curb stop, meter box and meter box cover, in accordance with standard details. Water meter boxes shall be installed in accordance with standard details to line and grade set by the Developer's Engineer. Upon acceptance, the Developer shall be responsible for damage to water meter boxes and covers until such time as the meters are installed by the Contracting Agency.

After the installation and acceptance of the water main and meter service pipe connections the water meter will be installed by the Contracting Agency upon proper application and payment of prevailing fees.

**631.3.2 Standards:** Except as otherwise specified all work shall be done in accordance with Sections 601 and 610.

**631.3.3 Excavation and Backfill:** The backfilling and compaction may be done as soon as the service line is installed, except backfilling and compaction shall not be completed around the corporation stop at the main water line until after inspection and recording of all tap locations. Trench bottom must be smooth and free of sharp objects. The minimum width of trench for water service pipe shall be 75 mm. The minimum depth of service pipe shall be 750 mm below the finished paving grade.

**631.3.4 Polyethylene Pipe:** Polyethylene pipe shall not be kinked, gouged or damaged during installation and backfilling operations. The pipe shall be placed in the trench allowing at least 300 mm per 30 m for thermal contraction and expansion. Polyethylene pipe has a high thermal expansion and should never be confined under tension. The pipe should not be stored in the sun or left in the trench under abnormal high temperature. The pipe shall be carefully snaked in the trench bottom and covered up with uniform slack throughout its length. In trenches less than 200 mm in width, the expansion shall be obtained by making the tap on the opposite side of the main from the water meter and providing a loop of slack service pipe back over the top of the water main. Before installing, inspect pipe to detect any damage that may be caused by shipping, storage or handling. Damage spots can be cut out and pipe recoupled with Ford C-66-33, C-66-44, or approved equal brass compression fitting to form a continuous length. Damaged pipe shall not be used. Polyethylene pipe shall be cut only with a tubing cutter with rollers properly designated for the size of pipe being cut. When polyethylene pipe is used, the meter box setting must be placed parallel to the back of the sidewalk in accordance with standard details. Polyethylene pipe shall be installed with large sweeping bends with radius of not less than 450 mm. Polyethylene pipe has a cold flow characteristic and must not be installed under a stressed condition. Compression fittings only may be used with the plastic being held securely between metal to metal. Stainless steel or brass inserts shall be placed in the proper position in each compression fitting with care taken to assure that the insert remains in place when the fitting is tightened. All meter service lines shall extend at right angles from the main to the curb lines.

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**631.3.5 Service Taps:** 25 mm and 19 mm service taps to new meter mains may be made with a saddle, tapped coupling or direct tap in accordance with the following provisions:

The Developer may use heavy tapped couplings for meter service connections on all sizes of pipe including the 75 mm pipe in cul-de-sac streets. Bronze corporation stops must be installed in the tapped couplings prior to pressure testing or disinfection of the water main. Normally in subdivisions no saddles are required for 150 mm pipe and larger. At the Contractor's option, saddles may be used on all 150 mm pipe and larger. All service connections on major and collector streets shall be made with saddles or heavy duty tapped couplings regardless of the water main size or service pipe size. All taps on pipe smaller than 150 mm must be made by either a saddle or heavy tapped coupling with bronze insert. Direct taps must be made by the use of a corporation stop with tapered AWWA machine thread. All wet taps must be made by the Mueller Type B-100 tapping machine or approved equal. A sharp tapping bit must be used in order to obtain clean sharp threads. In general, each tapping tool should be resharpened or discarded after making 6 taps. All copper service pipe which is attached to metallic water mains shall be insulated at the corporation stop with a dielectric insulator. The minimum distance between taps, saddles, and tapped couplings shall be 900 mm.

### **631.4 TESTING:**

All services, service taps and fittings shall be tested along with the water main in accordance with Subsection 610.14.

### **631.5 CLEANUP AND COMPLETION:**

Upon completion and acceptance of all phases of the water main and meter service lines the Developer shall release the new subdivision water system to the Contracting Agency for final operation and maintenance with all interior valves and corporation stops in open position and with all meter curb stops and valves at the connections to existing mains closed.

### **631.6 INSPECTION:**

The Developer's Engineer shall make an as-built plan and make a record of the locations of all water service connections prior to the connections being covered up. This as-built plan shall give the stationing of each service tap. The stationing to be continuous for each street, and shall begin at the street intersection or property line at the end of the block.

### **631.7 SERVICE OVER 50 MILLIMETERS:**

All service taps larger than 50 mm shall be made by the Agency after an application and payment of prevailing fees, unless otherwise required by the Agency.

### **631.8 SERVICE ON EXISTING MAINS:**

Where all or part of a new subdivision is served by existing water mains, only authorized personnel of the Contracting Agency shall install the service connections upon proper application and payment of prevailing fees.

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End of Section

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## SECTION 725

**725.8.3 Hand Mixed Concrete:** Hand mixed concrete shall be prepared on a watertight level platform in batches of not to exceed 0.25 cubic meter each. The required amount of coarse aggregate shall first be spread on the platform in an even and uniform layer, over which the proper proportion of fine aggregate shall then be likewise spread. The combined depth of both such layers shall not be greater than 300 mm. The required quantity of cement shall then be evenly distributed over the fine aggregate; following which the entire batch shall be turned with shovels at least twice before the water is added. The proper amount of water shall then be uniformly sprinkled or sprayed over the batch, which shall thereafter be returned with shovels not less than 3 times before being removed from the platform.

**725.8.4 Drybatched Unmixed Concrete:** Should the Contractor elect to use drybatched unmixed concrete, an accurate automatic batch mass recorder shall be provided to record the quantities of cement, aggregate and water batched into the containers; the mass of cement shall be recorded on either a separate charge from the aggregate or on the same chart using a separate needle. The recorder shall produce an autographic readable record on a visible chart of the masses of each of the materials batched. After batching, the needle on the chart shall return to zero. The chart scale along the ordinate shall be such that the major portion of the chart is used to record the total mass of the aggregates and water, and the cement. The date of batching, the container number and the batching certificate number shall be recorded on the recorder chart at the time of batching. The recorder charts, or copies thereof, shall become the property of the Contracting Agency and shall be submitted upon request.

All drybatched unmixed concrete delivered to the job site shall be stored in containers so constructed that the cement cannot come in contact with the water and aggregate within the container. Any admixture added to powder form shall be added to the cement; added in liquid form, it shall be added to the water.

The contents of the container shall be discharged into a mixer at the job site. Following discharge of the first container into the mixer, the mixer shall be operated at mixing speeds during the discharge of the remaining containers. After the contents of the last container have been discharged into the mixer, the concrete shall be mixed as specified in this specification for transit mixers, and drum or turbine type mixers.

Any spillage of cement, aggregate, water or admixture during the filling, transporting, or the discharging of the container, shall be cause for rejection of the container or the contents of the mixer if any portion of the rejected container is discharged into the mixer.

### **725.9 LOADING AND TRANSPORTATION OF MATERIALS AND MIXED CONCRETE:**

The compartments of trucks or other equipment used for the purpose of transporting proportioned aggregates, bulk cement or mixed concrete, shall be sufficiently high and tight, and otherwise suitably constructed and adequately protected, to prevent loss or leakage of the contents thereof during transit or charging.

### **725.10 TESTS:**

Concrete specimens for compression tests will be taken in the field by a representative of the Engineer in accordance with ASTM C-172 and C-31 or AASHTO T-23, except as noted hereinafter.

Concrete samples shall be taken from the approximate middle 50 percent of the batch in an uninterrupted stream from the chute directly into the wheelbarrow or similar equipment. Where excessive slump is suspected, a controlling slump test may be made from any portion of the batch, except for the approximate 5 percent on each end of the discharge. If excessive slump is verified, at any time, the remainder of the load shall be rejected and removed from the project and a set of cylinders for compressive strength shall be taken from the batch, if any concrete from the batch was placed. The rate of discharge of the batch shall be regulated by the rate of revolutions of the drum and not by the size of the gate opening. Specimens for compression tests shall be stored in the field in accordance with methods approved by the Contracting Agency and protected from vibration and other disturbances, for a minimum of 28 hours and maximum of 76 hours. A maximum storage period would be involved only where weekends or holidays are involved. Cylinders stored in the field for the maximum period shall have the same validity as cylinders that have been stored overnight and brought in the following day.

Not less than 4 cylinder specimens will be made for each 40 cubic meters of each class of concrete with a minimum of 4 specimens for each class placed or not less than 4 specimens for each half-day's pour. Specimens will be tested in a laboratory designated by the Engineer in accordance with ASTM C-39 at the expense of the Contracting Agency.

**SECTION 725**

Two cylinders shall be tested at 14 days. If their strength meets or exceeds the minimum 14-day requirements, the Contracting Agency will accept the concrete. The Engineer may test the other two cylinders at 28 days or discard at 60 days.

If this strength does not meet the 14-day requirement, the Contractor shall schedule and pay for two cores to be taken, on the 29th day, from the area of concrete represented by the cylinders. The Engineer shall be present when the coring is accomplished or additional cores will be required.

The Engineer will test the remaining two cylinders on the 28th day. If this test meets or exceeds the 28-day minimum compressive strength requirement, the Contracting Agency will accept the concrete and the Contractor may cancel the scheduled coring.

If the 28-day cylinder test does not meet the minimum 28-day compressive strength requirement, the cores will be tested in accordance with ASTM C-42 in a laboratory designated by the Contracting Agency. If the cores meet or exceed the minimum 28-day strength, the concrete will be accepted by the Contracting Agency.

If the strength of the 28-day cylinders and the strength of the cores as calculated in accordance with ASTM C-42 are deficient, the Contractor shall remove all of the concrete represented by the failing test specimens with the exception that if the Contractor believes that the deficient concrete was confined to a single batch, he may immediately cut a minimum of 4 additional cores, two on either side of the affected batch. The cores would be compared with the minimum specified compressive strength, for the purpose of defining the confines of the deficient concrete. All coring done to establish this premise would be at the expense of the Contractor. Evaluation of the cores shall be by the Engineer, or by a substitute agent designated by the Contracting Agency, and his decision shall be final.

**725.11 ACCEPTANCE:**

Concrete represented by a strength test of at least 95% of the required 28-day compressive strength will be acceptable. All concrete failing to meet this requirement as evidenced by tests of either standard cylinder or drilled core specimens shall be rejected, removed and replaced by the Contractor at the Contractor's expense.

When concrete is accepted on the basis of strength tests of less than 100% of the required minimum 28-day compressive strength, an adjustment in the contract unit price will be made for the quantity of concrete represented by such strength tests in accordance with the following schedule:

**Adjustment in Contract Unit Price for Strength Deficiency**

**Percent of Specified Minimum 28-Day Compressive Strength Attained (Nearest 1%)**

**Percent of Concrete Unit Price Allowed**

100% or greater	100
98-99	90
96-97	85
95	80

End of Section

## SECTION 728

### CONTROLLED LOW STRENGTH MATERIAL

#### 728.1 GENERAL:

Controlled Low Strength Material (CLSM) is a mixture of portland cement, aggregate and water that, as the cement hydrates, forms a soil replacement. CLSM is a self-compacting, flowable, cementitious material that is primarily used as a backfill or structural fill in lieu of compacted fill or unsuitable native material.

#### 728.2 MATERIALS:

Portland Cement shall conform to Section 725.2.  
Coarse and fine aggregates shall conform to Section 701.  
Water shall conform to Section 725.5.

#### 728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES:

Proportioning of the mixture shall comply to Section 701.3.5, Section 725.7 and Table 728-1. A mix design shall be submitted with test data for the Engineer's approval prior to the excavation for which the material is intended for use.

TABLE 728-1			
CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS			
Description of CLSM	Cement Content, kg/m <sup>3</sup>	Slump, mm	Compressive Strength at 28 days, MPa
½ Sack CLSM	28 ±5%	175 ±25	0.48 ±0.21
1 Sack CLSM	56 ±5%	175 ±25	1.03 ±0.35
1 ½ Sack CLSM	84 ±5%	175 ±25	2.93 ±0.52

Notes for Table 728-1:

- C The values specified in the table are for both mix design requirements and field production. The deviations are for production, testing and sampling tolerances.
- C Slump shall be tested in accordance with ASTM C-143. Flow consistency test can be substituted for the slump test. When used, the CLSM shall have a flow consistency of 200 mm as tested in accordance with ASTM D-6103.
- C Compressive strength shall be tested in accordance with ASTM D-4832. The supplier shall provide laboratory and/or field test data to verify the design strength.
- C Sampling shall be in accordance with ASTM D-4832.
- C Unit mass -
- C shall be obtained by ASTM D-6023.
- C Temperature shall be taken in accordance with ASTM C-1064.
- C Cement content shall be tested in accordance with ASTM D-5982.

Where CLSM is to be used as backfill around gas pipelines (totally encapsulating the gas pipeline), the material shall meet a minimum permeability coefficient (k) of  $1 \times 10^{-5}$  cm/sec or more, based on ASTM D-5048.

#### 728.4 MIXING:

The total elapsed time between the addition of the water and placement of the complete mix shall not exceed 90 minutes. The Engineer may waive this limitation if the slump is such that the material can be placed without addition of water.

Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogenous, readily placeable and uniformly workable. Proportioning of ingredients shall produce consistency, durability, workability and other required properties appropriate for the intended usage. When the CLSM is mixed other than at the project site, the mixing shall comply with Section 725.8. When the CLSM is mixed at the job site, the Contractor will submit for the Engineer's approval, the methods, equipment and procedures for proportioning and mixing of the material.

End of Section

**SECTION 729**

**EXPANSION JOINT FILLER**

**729.1 PREMOLEDDED JOINT FILLER:**

Expansion joint filler materials shall consist of premolded strips of a durable resilient compound and comply with ASTM D-1751, D-1752, or D-2628, as specified by the Contracting Agency.

**729.2 POUR TYPE JOINT FILLERS:**

Pour type joint fillers shall comply with ASTM D-1850, D-1190, D-1854, or with the following formulation, as specified by the Contracting Agency.

Asphalt latex joint filler shall consist of asphalt latex emulsion and sodium fluosilicate furnished in separate containers and mixed on the site. The emulsion shall consist by volume of 60 parts AR-1000 asphalt conforming to the requirements of Section 711, 40 parts of synthetic latex, GRS-Type 4, and 5 to 10 parts of sodium fluosilicate, half strength. The emulsion and sodium fluosilicate shall not be mixed until the joint is ready to be filled. The amount of sodium fluosilicate to be mixed with the emulsion shall be approximately 3 to 5 percent by mass of the emulsion. The joint to be filled shall be thoroughly cleaned and surface dry.

The sealing compound shall consist of paving asphalt, Grade AR-1000 conforming to the provisions of Section 711, emulsified with rubber latex in the presence of a suitable emulsifying agent. Rubber latex designated as GRS-Type 4, or any other approved type, containing approximately 40 percent solids.

The resulting emulsion shall consist of a minimum of 55 percent of paving asphalt and a minimum of 36 percent of rubber latex and shall conform to the requirements set forth in Table 729-1.

<b>TABLE 729-1</b>			
<b>ASPHALT-LATEX EMULSION JOINT SEALING COMPOUND</b>			
<b>SPECIFICATION DESIGNATION</b>	<b>TEST METHOD</b>	<b>LIMITS</b>	<b>REMARKS</b>
Furol Viscosity at 25EC.	AASHTO T-72	50-250 seconds	Before adding gelling agent.
Sieve Test	AASHTO T-59	1% Max.	Before adding gelling agent.
Penetration at 25EC	ASTM D-217	50-250	The penetration test is made on a specimen prepared by stirring 5% of sodium fluosilicate into the asphalt latex emulsion in a 200 mL deep ointment can. The specimen is then allowed to stand in the air at a temperature of 25EC. ± 1EC for a period of 30 minutes and is then penetrated with a grease cone under a total load of 150 grams.
Elasticity		70% Min.	After addition of 5% of sodium fluosilicate and curing for 24 hours at 38EC. ± 1EC, the specimen shall have an elastic recovery of not less than 70%.
Dehydration		Loss 30% maximum	Twenty-five grams of emulsion, prior to adding the gelling agent, is placed in a 250 mL flat ointment can and dehydrated in a suitable oven maintained at a temperature of 93EC. ± 1EC for a period of 24 hours.
Time of Set		15-60 minutes	After mixing the emulsion with 1% to 4% by mass of powdered sodium fluosilicate the emulsion shall harden or develop a set in from 16 to 60 minutes, under field conditions.

## SECTION 753

### GALVANIZED PIPE AND FITTINGS

#### 753.1 GENERAL:

All galvanized pipe shall be new galvanized welded or seamless steel pipe, conforming to the requirements of ASTM A-53 standard mass, schedule 40.

#### 753.2 CORROSION PROTECTION:

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coating shall be not less than 760 Fm in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extrucoat or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, coal tar or asphalt tape, Pretecto Wrap No. 200, Saft-t-Clad FOS No. 655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchrap No. 50 or approved equal Tape shall be edge lapped no less than 6 mm.

#### 753.3 FITTINGS:

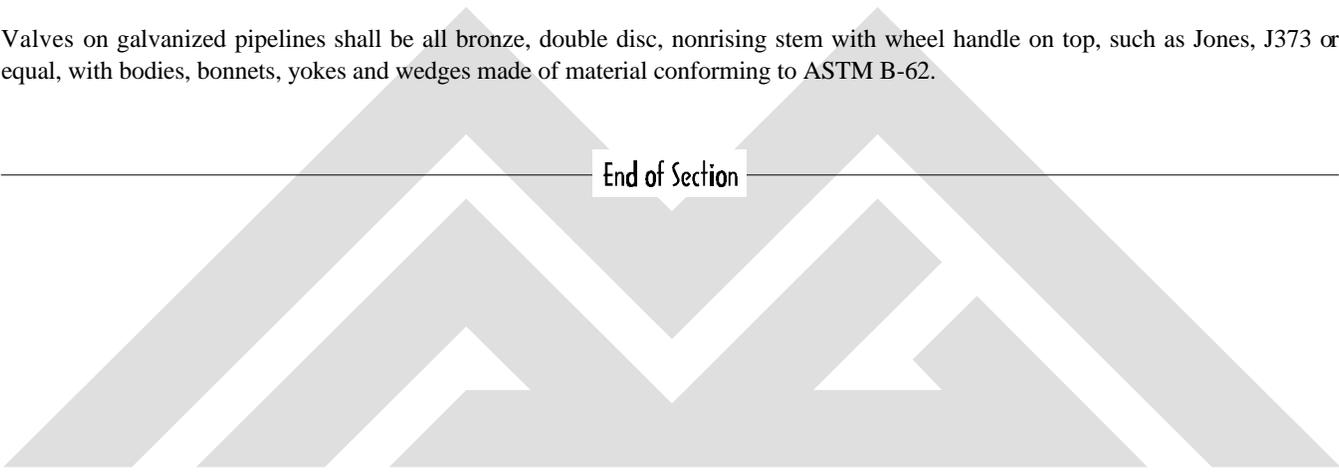
All fittings for screwed galvanized pipes shall be 1034 kPa, banded, galvanized malleable iron screwed fittings.

#### 753.4 VALVES:

Valves on galvanized pipelines shall be all bronze, double disc, nonrising stem with wheel handle on top, such as Jones, J373 or equal, with bodies, bonnets, yokes and wedges made of material conforming to ASTM B-62.

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End of Section



## SECTION 754

### COPPER PIPE, TUBING AND FITTINGS

#### 754.1 PIPE AND TUBING:

All copper pipe and tubing shall be new seamless copper pipes and tubes, designed for underground water services, plumbing purposes, etc. They shall conform to all the requirements of ASTM B-88, Type K.

All pipe or tubing shall be made of copper free from cuprous oxide, as determined by microscopic examination at a magnification of 75 diameters.

Type K tubing, when furnished in coil, shall be annealed after coiling.

#### 754.2 FITTINGS:

All fittings used in connection with copper pipe or tubing, shall be copper or bronze fittings as manufactured by Jones, Mueller, or approved equal, as shown on standard details.

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End of Section



**SECTION 765**

**RUBBER GASKETS FOR CONCRETE PIPE**

**765.1 GENERAL:**

The joints of concrete pipe shall be O-ring rubber gasket joints conforming to ASTM C-361 except the composition and properties of the rubber gaskets shall be as follows:

All rubber gaskets shall be extruded or molded and cured in such a manner as to be dense, homogeneous, and free from porosity and other imperfections. The tolerance for any diameter measured at any cross section shall be  $\pm 794$  Fm. All gaskets shall be manufactured from a synthetic rubber compound in which the elastomer is chloroprene (ASTM-SAE Designation Type SC) exclusively. Said compound shall contain not less than 50 percent by volume of neoprene, shall contain no deleterious substances, and shall conform to Table 765-1.

<b>TABLE 765-1</b>		
<b>RUBBER GASKETS</b>		
<b>Physical Properties</b>	<b>Value</b>	<b>Method of Test</b>
Tensile strength, Min. MPa	10.3	ASTM D-412
Elongation at break, Min. %	425	ASTM D-412
Shore durometer hardness, Type A. (1)	40-60	ASTM D-2240
Compression set, Max. % of original deflection, (2)	20	ASTM D-395
Accelerated aging, tensile strength, %, (3)	80	ASTM D-572
Max. increase over original shore durometer value after accelerated aging.	8	ASTM D-2240
Specific Gravity	0.95-1.45 $\pm 0.05$	ASTM D-297

(1) Pipe manufacturer shall select value suitable to type of joint.

(2) Use Method B, except disc shall be 12.7 mm long section of rubber gasket stock.

(3) Percent of tensile strength, after aging by the oxygen-pressure chamber (96 hours,  $70 \pm 1$ EC.  $2070 \pm 100$  kPa), of the tensile strength before aging.

It is the intent of these specifications that the gasket container shall be a preformed rectangular groove so constructed that when 2 pipes are joined together the rubber gasket shall be compressed and for all practical purposes substantially fill and be largely confined within the rectangular groove.

The Contractor shall submit for approval details of the shape and size of the gaskets he proposes to furnish. The Contractor shall submit certified test results in triplicate showing the physical properties of the materials used in the manufacturer of gaskets.

End of Section

## SECTION 770

### STRUCTURAL AND RIVET STEEL, RIVETS, BOLTS, PINS, AND ANCHOR BOLTS

#### 770.1 GENERAL:

All steel, unless otherwise designated on the plans or in the special provisions, shall conform to the requirements of ASTM A-36.

Report of Tests: Before fabrication, the Contractor shall furnish to the Engineer a certified mill report in triplicate, for each identifiable melt of steel or iron from which the material is to be fabricated. The report shall include the chemical and physical tests required by the ASTM specifications.

Additional Tests: The Contracting Agency reserves the right to require and to make additional mill and laboratory tests. The number of such additional tests will be limited as follows, except that in the case of failure of the material to comply with the ASTM requirements, more tests will be made:

Structural steel, 1 complete test for each heat or each 10000 kg of identifiable stock. Rivets, 1 complete test for each size. Bolts, 1 complete test for each lot.

Identifiable stock is material for which authentic records of the chemical and physical properties are available.

Test specimens shall be furnished, cut, and machined in accordance with the ASTM specification, for the material to be tested, as referred to herein. Test specimens shall be furnished and machined by the Contractor at no additional cost to the Contracting Agency.

Mill Tolerances: Rolling and cutting tolerances, permissible variations in mass and dimensions, defects and imperfections shall not exceed the limits for structural steel contained in ASTM A-6.

Stock Material: When the Contractor proposes to use material already in stock, he shall notify the Engineer of such intention at least 10 days in advance of beginning fabrication, to permit sampling and testing.

#### 770.2 STRUCTURAL STEEL:

Stock Materials: The Contractor shall select the material he wishes to use from stock. The Contractor shall furnish 3 certified mill reports for each of the heat numbers. Two samples shall be taken by a representative of the Engineer from each heat number, one for the tension test and one for the coldbend test. If the heat numbers cannot be identified, the representative of the Engineer shall select random test specimens from the unidentifiable heats. The number of such test specimens shall be at the discretion of the Engineer. The cost of all tests on stock material shall be borne by the Contractor.

High Strength Low-Alloy Structural Steel: The material shall conform to the requirements of ASTM A-242, A-572/A-572M, A-606, A-607 or A-653M Grades C, D, or E as specified in the special provisions.

Copper Bearing Structural Steel: Copper bearing structural steel shall conform to the requirements of ASTM A-36, A-570, A-611, or A-653M as specified in the special provisions.

#### 770.3 RIVETS:

Stock Material: Rivets taken from identifiable stock shall be accepted by the Engineer in accordance with this specification.

Rivets from unidentifiable stock, for which authentic records of the chemical and physical properties are not available, shall not be used except where shown on the plans or when approved by the Engineer.

High-Strength Structural Rivet Steel: The material shall conform to the requirements of ASTM A-502.

Structural Rivet Steel: The material shall conform to the requirements of ASTM A-502, except that the test specimen shall be bent upon itself when performing the bend test.

## SECTION 770

### 770.4 BOLTS:

Unfinished Bolts: The bolts shall have square heads and square nuts unless otherwise specified. The bolts shall be long enough to extend entirely through the nut but not more than 6 mm beyond. Washers shall not be furnished unless specified.

Steel bolts shall conform to the requirements of ASTM A-307, except that steel manufactured by the acid Bessemer process shall not be used.

High Strength Bolts: High strength bolts shall conform to the provisions of the specification for the design, fabrication and erection of structural steel for buildings of the AISC.

### 770.5 ANCHOR BOLTS:

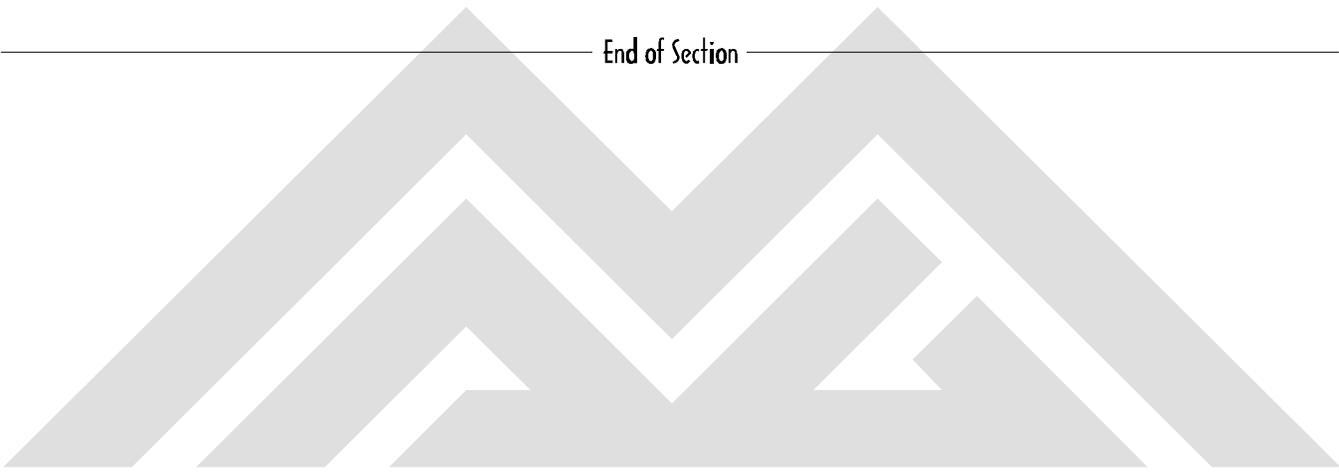
Anchor bolts shall be manufactured from steel conforming to ASTM A-36 or A-307.

### 770.6 MILD-STEEL FORGINGS FOR STRUCTURAL PURPOSES:

Steel forgings shall be made from steel of forging quality and shall conform to the requirements of ASTM A-668. They shall be Class C forgings with a maximum carbon content of 0.35 percent and shall be given a thorough annealing. The metal shall have a minimum Brinell hardness number of 130, and a maximum of 190, when tested in accordance with ASTM E-10.

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End of Section



## SECTION 771

### GALVANIZING

#### 771.1 GENERAL:

Materials shall be hot-dip galvanized and the mass and uniformity of coating determined in accordance with the standard specifications given in Table 771-1.

TABLE 771-1		
GALVANIZING SPECIFICATIONS		
Material	ASTM Spec.	Wt. of Coating g/m <sup>2</sup> (Min.)
Corrugated Metal Pipe	A-929	550
Flat Steel or Iron Sheets	A-653 A-924	381
Iron or Steel Wire	A-116	244
Chain Link Fabric	A-392	366
Barbed Wire	A-121	153
Steel Pipe Rails	A-53	550
Structural Shapes, Tie Rods, Ornamental Iron Railings, Handrails, Manhole and Catch Basin Steps, and Curb Armor	A-123	610
Bolts, Nuts, Washers, Anchor Bolts, Packing Spools, Gray Iron and Malleable Iron Castings and Steel Castings	A-153	381

#### 771.2 WORKMANSHIP:

The galvanizing shall be applied in such a manner that the spelter will not peel off. The finished product shall be free from blisters and excess spelter, and the coating shall be even, smooth, and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting and other fabricating shall all be done as far as is practicable before the galvanizing. No member shall be galvanized which is out of alignment. All members (nuts, bolts, washers, etc.) shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings due to poor workmanship, rough handling, or any other reason shall be cause for rejection.

#### 771.3 TEST COUPONS:

Test coupons for determining the quality of the galvanizing shall be wired to the materials to be galvanized before immersion in such a manner as to represent the amount of coating deposited on the materials.

#### 771.4 REPAIR OF GALVANIZED SURFACES:

Unless otherwise specified, where galvanized surfaces are field or shop cut, broken, burned or abraded, thus breaking the galvanizing, the locations thus damaged shall be repaired to the satisfaction of the Engineer with zinc dust-zinc oxide coating conforming to AASHTO M-36.

End of Section

## SECTION 772

### CHAIN LINK FENCE

#### 772.1 GENERAL:

All material shall be new and, upon request, the Contractor shall furnish to the Contracting Agency, a certification of inspection stating that the materials have been manufactured, sampled, tested and inspected so as to meet the requirements for its type as specified below.

#### 772.2 POSTS, RAILS AND BRACES:

Posts, rails and braces shall be constructed of pipe in conformance with types A, B or C below. Unless specifically designated by type in the plans or specifications, the Contractor may utilize any of the three types. The posts and rails in this section will cover fencing up to 3.66 m in height with post spacing not to exceed 3 m. The nominal outside dimensions and minimum mass shall be in accordance with Table 772-1. The manufacturer or his representative shall legibly mark each length of pipe by rolling, stamping or stenciling to identify the product by product name, ASTM standard, etc. and the country of manufacture.

**Type A:** Pipe shall be black steel, welded or seamless, hot-dipped zinc coated, manufactured in conformance to ASTM F-1083, plain end, standard mass (schedule 40). The hot-dipped zinc coating (galvanized) shall be applied both inside and outside with not less than  $550 \text{ g/m}^2 \pm 2.8 \text{ g}$ .

**Type B:** Steel used in the manufacturing of the pipe shall be hot-rolled strip steel in compliance with ASTM A-569 having a minimum yield strength of 345 MPa. The pipe will be manufactured by electric welded cold-formed process per ASTM A-500. The exterior surface will be triple coated and the interior surface single coated per ASTM F-1043. The triple coated external surface shall be hot-dipped zinc coated (galvanized) having a mass of not less than  $305 \text{ g/m}^2 \pm 30\text{g}$ ., followed by a chromate conversion coating, having a mass not less than  $0.0465 \text{ Fg/mm}^2 \pm 0.023 \text{ Fg}$  and an acrylic coating having a thickness of  $13 \text{ Fm} \pm 5 \text{ Fm}$ . The internal surface shall be coated with a zinc base paint having a 90% zinc powder loading and having a minimum thickness of 13 Fm.

**Type C:** Steel used in the manufacturing of the pipe shall be strip steel in compliance with ASTM A-653M Grade D having a minimum yield strength of 345 MPa. Both sides of the strip shall be hot-dipped zinc coated (galvanized) per ASTM A-653 and A-924 having the mass of not less than  $305 \text{ g/m}^2 \pm 30 \text{ g}$ . The zinc coating will form the first coat of a triple coated external surface and the final coat of the interior surface. The pipe will be manufactured by electric welded cold formed process per ASTM A-789M. After manufacturing, the final two external coatings shall be a chromate conversion having a mass of not less than  $0.0465 \text{ Fg/mm}^2 \pm 0.023 \text{ Fg}$  and an acrylic coating having a thickness of  $13 \text{ Fm} \pm 5 \text{ Fm}$ .

#### 772.3 CHAIN LINK FABRIC:

Chain link fabric shall conform to the requirements of ASTM A-392 (Zinc-Coated) or ASTM A-491 (Aluminum-Coated). The coating process must leave the fabric completely free of barbs, icicles, or other projections which might be hazardous. The wire used in the manufacture of the fabric shall be 305 mm for all fence 1524 mm or less in height and shall be 3.76 mm for all fence over 1524 mm in height unless otherwise specified.

All chain link fabric shall be woven into approximately 50 mm mesh. Fabric less than 1524 mm wide shall have knuckled finish on the top edge, and twisted and barbed finish on the bottom edge. 1524 mm or greater in width shall have twisted and barbed finish on both edges. Barbing shall be done by cutting the wire on the bias.

#### 772.4 TENSION WIRES AND FABRIC TIES:

Tension wires shall be at least 4.50 mm galvanized coil spring steel wire per ASTM A-824. Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 3.05 mm galvanized steel, 4.88 mm aluminum wire, or approved non-corrosive metal bands.

Tension bars used in fastening fabric to end and corner posts and gate frames shall be galvanized high carbon steel bars not smaller than 5 mm x 19 mm.

**SECTION 772**

<b>TABLE 772-1</b>					
<b>FENCE MEMBER SIZES &amp; MASS</b>					
<b>USE</b>	<b>FENCE HEIGHT (m)</b>	<b>NPS DESIGNATOR</b>	<b>OUTSIDE DIAMETER (mm)</b>	<b>MASS (kg/m Minimum)</b>	
				<b>TYPE A Schedule 40</b>	<b>TYPE B and C</b>
<b>FENCE POSTS</b>					
End, corner, slope, pull and strain posts	Less than 1.83	2	60.3	5.4	4.6
	1.83 and over but less than 2.74	2½	73	8.6	6.9
	2.74 and over but not over 3.66	3½	101.6	13.6	9.8
Line posts	less than 1.83	1½	48.3	4.0	3.4
	1.83 and over but less than 2.75	2	60.3	5.4	4.6
	2.75 and over but not over 3.66	2½	73	8.6	6.9
<b>GATE POSTS</b>					
Single swing gates 1.83 m or less in width or double swing gates 3.66 m or less	less than 1.83	2	60.3	5.4	4.6
	1.83 and over but not over 3.66	3½	101.6	13.6	9.8
Single swing gates over 1.83 m but not over 3.96 m in width or double swing gates over 3.66 m but not over 7.93 m in width	—	3½	101.6	13.6	9.8
Single swing gates over 3.96 m but not over 5.49 m in width or double swing gates over 7.92 m but not over 10.97 m in width	—	6	168.3	28.3	—
Single swing gates over 5.49 m in width or double swing gates over 10.97m in width	—	8	219.1	42.5	—
<b>OTHER MEMBERS</b>					
Top rail and braces	—	1¼	42.2	3.4	2.7
Frame for gates	—	1½	48.3	4.0	3.4
Stiffners for gates	—	1¼	42.2	3.4	2.7

Notes to Table 772-1:

- C All unit masses shall be subject to the standard mill tolerance of ± 5 percent.
- C Posts shall be fitted with tops designed so as to fit securely over the posts and carry a top rail where specified. They shall have a total length of not less than the depth of the concrete footings, as specified, plus the length required above ground. Where no top rail is required, pipe posts shall be fitted with suitable caps.
- C Top rail shall be furnished in random lengths of approximately 6.1 m where required.

## SECTION 772

### 772.5 TRUSS OR TENSION RODS:

Truss or tension rods used in trussing gate frames and line posts adjacent to end, corner, slope or gate posts shall be adjustable 10 mm diameter galvanized steel rod. When used in trussing line posts, adjustment shall be provided by means of galvanized, turnbuckle or other suitable tightening devices.

### 772.6 FITTINGS:

Fittings shall conform to ASTM F-626.

Fittings, hardware, nuts and bolts shall be galvanized.

Couplings to connect the individual lengths of top rail shall be of the outside sleeve type at least 178 mm long. The bore of the sleeves shall be sufficiently true to maintain adjacent lengths of rail in alignment.

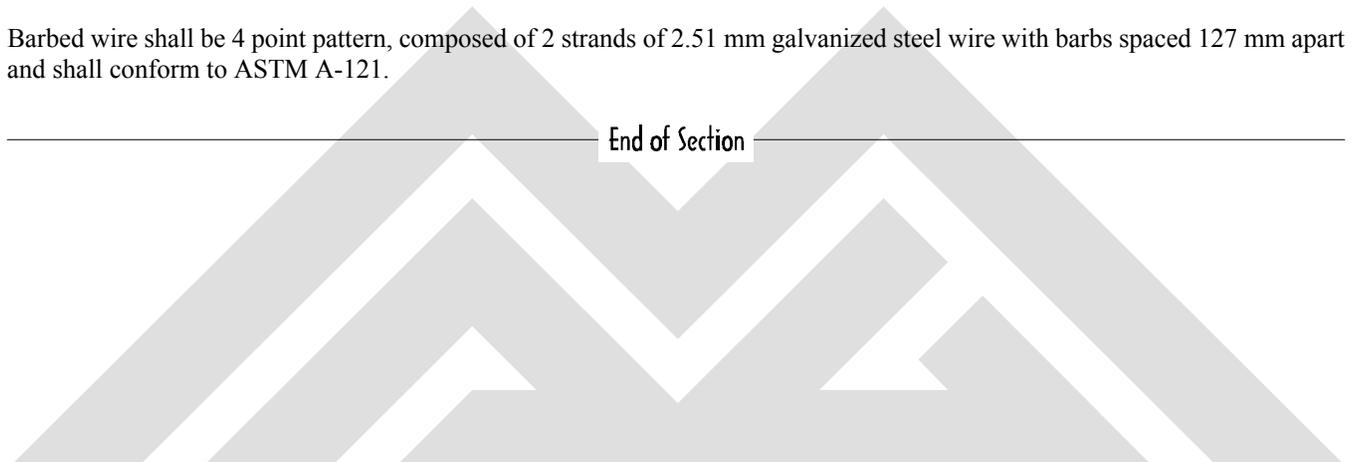
Extension arms for barbed wire on pipe posts shall be of 2.34 mm steel or heavier, single piece construction and a type that can be attached to the tops of the posts. Extension arms shall carry 3 wires at approximately 140 mm centers in a plane approximately 45 degrees from the vertical, inclined as shown on the plans or as directed by the Engineer.

### 772.7 BARBED WIRE:

Barbed wire shall be 4 point pattern, composed of 2 strands of 2.51 mm galvanized steel wire with barbs spaced 127 mm apart and shall conform to ASTM A-121.

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End of Section



## SECTION 775

### BRICK AND CONCRETE MASONRY UNITS (BLOCKS)

#### 775.1 BRICK:

Brick shall be whole, sound, and hard burned and shall give a clear ringing sound when struck together. They shall be uniform in quality and shall be culled or sorted before delivery to the work.

#### 775.1.1 MANHOLE BRICK:

Sewer and water manhole brick shall conform, except for dimensional tolerances, to the requirements of ASTM C-32, Grade MM.

Manhole brick shall conform to Table 775-1.

TABLE 775-1			
MANHOLE BRICK DIMENSIONS			
Brick	mm Depth	mm Width	mm Length
Standard Metric Modular Size Allowable Variations	57 ±3	90 ±3	190 ±6

The following paragraphs shall be added to the section on visual inspection:

No individual brick shall be rejected unless it shows visual evidence of major cracking. A major crack is defined as one that has at least one complete separation, for a distance of 45 mm, through the brick in any direction, including any cored area. Such a crack shall be regarded as affecting the serviceability of the brick and shall be rejected and not used in the structure.

Fifty bricks may be sampled at random intervals from any cube for visual inspection. Of the 50 samples, 45 must pass visual inspection for major cracks. Should less than 45 pass, the cube of brick shall be rejected and the brick must not be used in the structure.

#### 775.1.2 BUILDING BRICK:

Building brick shall conform to the requirements of ASTM C-62, grade MW.

#### 775.1.3 FACING BRICK:

Facing brick shall conform to the requirements of ASTM C-216, Grade MW, Type FBS. The size, color, and texture shall be as specified on the plans or as approved by the Engineer.

#### 775.2 CONCRETE MASONRY UNITS:

Unless otherwise noted on the plans or special provisions, concrete masonry units shall conform to ASTM C-90, Normal Weight, Type I with a minimum compressive strength of 13.1 MPa.

The units shall be fully cured and shall have been made not less than 28 days prior to delivery.

The moisture content at the time of delivery shall not exceed 30 percent of the minimum absorption value of the units. The Contractor shall provide any protection he deems necessary to maintain the units in this condition until time of use.

The linear change from saturated to cool oven dry shall not exceed 450 Fm per linear meter or 0.045 of 1 percent conducted in accordance with test method in ASTM C-426.

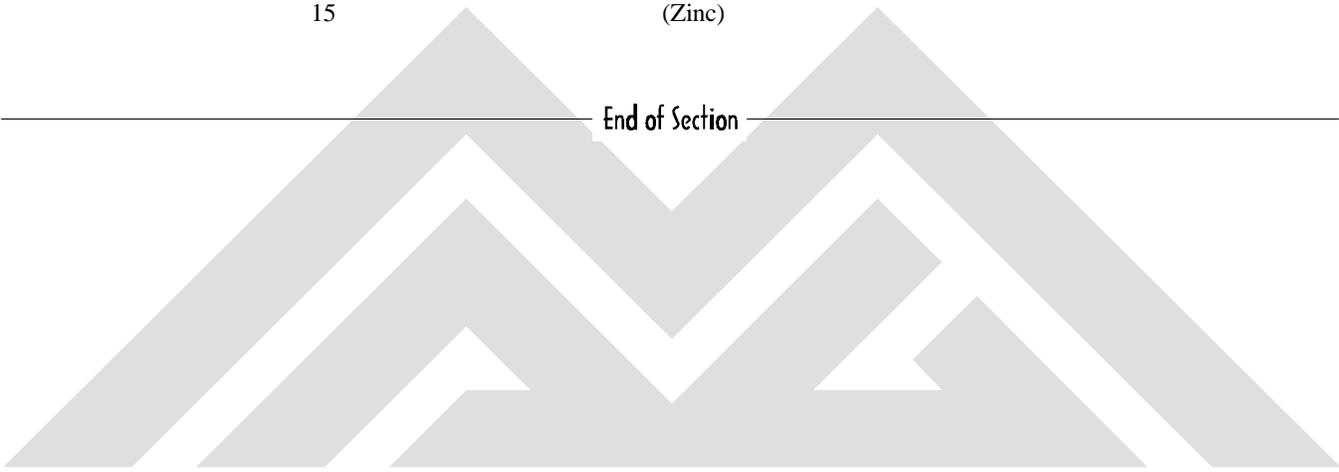
The units shall be made with normal mass aggregate conforming to ASTM C-33.

## SECTION 790

<b>Paint Number</b>	<b>Type</b>
1-A	(Red Lead — Linseed Oil)
1-B	(Red Lead — Alkyd Resin)
1-D	(Zinc Chromate)
4	(Dull Black)
5	(Jet Black)
6	(Black — For Timber Primer Only)
7	(White — For Timber Primer Only)
8	(White)
9	(Light Grey)
10	(Aluminum)
11	(White Enamel)
15	(Zinc)

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End of Section



**SECTION 792**

**DUST PALLIATIVE**

**792.1 GENERAL:**

Dust palliatives shall consist of various chemical dust suppressants which work by binding together lighter soil particles.

All materials must meet the environmental requirements of Section 792.3 and must be approved by the Engineer prior to their use.

**792.2 TYPE OF MATERIALS AND APPLICATION RATES:**

Emulsions shall be miscible with water in all proportions as noted in Table 792-1. The dilution ratio will vary based upon the local soil and weather conditions. The ratios shall be proposed by the Contractor and agreed upon by the Engineer.

The rate of application noted in Table 792-1 shall be for the treatment, method and use specified by the Contracting Agency, or as directed by the Engineer. To compensate for local conditions, the Contractor may adjust the application rate within the ranges specified.

Products specifically formulated as tackifiers which prevent wind-blown erosion shall not be acceptable as dust palliatives for vehicular traffic, but may be used for their intended purposes.

TABLE 792-1				
DUST PALLIATIVE DILUTION RATIOS AND APPLICATION RATES				
Product Type	Use/Treatment (1)	Dilution Ratio (2)		Application Rate (3) [l/m <sup>2</sup> ]
		Range	Typical	
Acrylic Copolymer	Topical - Road or parking Lot	20:1 to 4:1	9:1	0.91 to 0.45
	Topical - Road Shoulder	20:1 to 4:1	15:1	0.72 to 0.41
	Surface Course (25 mm of depth)	20:1 to 4:1	9:1	0.45 to 0.29
Petroleum Resin Emulsified	Topical - Road or parking Lot	4:1	4:1	0.68 to 0.45
	Topical - Road Shoulder	10:1 to 7:1	8:1	0.68 to 0.32
	Surface Course (25 mm of depth)	4:1	4:1	0.50 to 0.32
Lignin-Based Type (Lignosulfonate)	Topical - Road or parking Lot	1:1	1:1	0.45 to 0.23
	Topical - Road Shoulder	7:1 to 4:1	4:1	0.23 to 0.14
	Surface Course (25 mm of depth)	1:1	1:1	1.36 to 0.45
Organic Resin	Topical - All	10:1 to 2:1	5:1	1.13 to 0.68
	Surface Course (25 mm of depth)	2:1 to 1:1	1:1	0.68 to 0.45
Other	As approved by the Engineer			

- (1) Topical application rates shown are to obtain 12 to 25 mm penetration. Higher rates should be used if greater penetration is anticipated.
- (2) The dilution ratio (water:product) is variable and shall be appropriate for the local soil and weather conditions, as proposed by the Contractor and agreed upon by the Engineer.
- (3) Application rate of undiluted concentrate.

(A) Acrylic Copolymer Types:

The material shall be a white or clear emulsion that can penetrate, saturate and bond together treated soils to create a hard, dust-free and water resistant surface. The material shall have the following properties in its undiluted state:

**SECTION 792**

<b>Specification Designation</b>	<b>ASTM Test Method</b>	<b>Requirements</b>
Composition	--	Acrylics, acrylates & acetates
pH	E 70	4.0 - 9.5
Residue (active solids content), %	D 244	40 min.
Flash Point, EC	D 92	None
Absolute Viscosity (Brookfield), cP, 25 EC	--	1500 max.
Specific Gravity, 15.5 EC	D 1298	1.00 - 1.15

**(B) Petroleum Resin Emulsified Types:**

The materials shall be a light yellow petroleum resinous emulsion suitable for use as an agglomerat for soil particles. The material shall have the following properties in its undiluted emulsified state:

<b>Specification Designation</b>	<b>ASTM Test Method</b>	<b>Requirements</b>
Kinematic Viscosity, SFS at 25 EC	D 244	15 min.
pH	E 70	4.0 - 7.0
Residue, % wt. (1)	D 244	64 ±4
Sieve Test, % wt. Retained (2)	D 244	0.1 max.
Particle Charge Test	D 244	Positive
Flash Point of base product, CO, EC	D 92	204 EC min.
Specific Gravity of base product, 15.5 EC	D 1298	1.00 to 1.04

(1) ASTM test modified by heating 50 g of sample to 149 EC until foaming ceases, then cooling immediately and calculation results.

(2) Replace 2% sodium oleate solution with distilled water in test.

The emulsion shall be stable, i.e., should not break when stored in clean closed containers at temperatures between 2 EC and 93 EC for a minimum of 3 months. The sequestering agents shall make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion shall be non-corrosive to metal containers. The materials shall penetrate into the soil and not form a skin at the surface or a crusted surface.

**(C) Lignin-Based Types:**

Lignin-based dust palliative shall be an aqueous lignosulfonates (a residual co-product of wood pulping by the sulfite process in the manufacturer of cellulose products) that dispersed readily in water to yield a stable, brown-colored solution. The material shall have the following properties in its undiluted state:

<b>Specification Designation</b>	<b>ASTM Test Method</b>	<b>Requirements</b>
Absolute Viscosity (Brookfield), cP, 25 EC	--	< 1,000
Residue (total solids content), %	D 244	48 min.
Lignin sulfonate content (% of solids)	D 244	60 min.
pH	E 70	5.0 - 7.0
Specific Gravity (liquid), 15.5 EC	D 1298	1.00 min.

SECTION 792

(D) Organic Resinous Types:

The material shall be a tan emulsion designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that utilizes non-petroleum based organic esters and resins combined with other additives to penetrate, bond and coat treated soils. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 25 EC	--	50 - 200
pH	E 70	3.0 - 9.0
Residue (active solids content), %	D 244	45 min
Flash Point	D 92	None
Specific Gravity, 15.5 EC	D 1298	1.00 min.

(E) Other Types:

Other types of dust palliative may be approved for use by the Engineer. Test methods, requirements, dilution ratios and application rates shall be as specified by the manufacturer.

792.3 ENVIRONMENTAL CRITERIA:

Products shall not contain or emit chlorinated fluorocarbons (CFS's Freon's) and shall not contain or emit volatile organic compounds (VOC's) that exceed Federal, State or Local air quality limitations.

Products and their degradation products shall not be composed of elements, compounds, mixtures or produce runoffs with the characteristics identified under ARS 36-2822 of the Arizona Hazardous Waste Management Act, emit or off-gas during placement, use or degradation of any hazardous air pollutant listed under Section 112 of the Federal Clean Air Act [42 U.S.C. § 7412], be a hazardous chemical substance or mixture pursuant to Section 7 of the Federal Toxic Substances Control Act [15 U.S.C. § 2606], be designated by rule an extremely hazardous chemical substance pursuant to the Arizona Environmental Quality Act, produce runoffs that contain concentrations exceeding the parameters designated in Section 2.18 'Table 5' of the NPDES Multi-Sector General Permit for Industrial Activities (see Note A), be prohibited for use by the Arizona Department of Environmental Quality, the Environmental Protection Agency, or any applicable law, rule or regulation.

Products or their components and degradation products shall be tested and certified by the manufacturer not to be substances or composed of substances known to be, or reasonably anticipated to be carcinogenic or toxic by the U.S. Department of Health and Human Services.

Products must have hazardous Materials Identification System (HMIS) ratings equal to or less than the following for each category: H=1; F=1; R=1; PPE=X.

Note A: Parameter benchmark values shall be provided by the Engineer and based on the Contracting Agency's requirements.

End of Section

**SECTION 795**

**LANDSCAPE MATERIAL**

**795.1 GENERAL:**

Material used for landscaping purposes shall be in conformance with this Section.

The common and scientific names of plants shall conform to the approved names in Standard Plants Names (SPN) or its successor, American Association of Nurserymen (ASN). For identification and inspection, durable, legible labels, bearing the plant's name in water-resistant ink, shall be attached to all nursery stock or container of stock delivered to the project site.

**795.2 TOPSOIL:**

Topsoil shall be a fertile, friable soil, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, noxious weeds or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the Contractor shall furnish the Engineer at no additional cost, with a soil sample from each source for analysis and tests.

To be acceptable the pH factor shall not exceed 8.0 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 15 inclusive, and it shall contain approximately 1½%, by dry weight, of organic matter either natural or added. Gradation shall be in accordance with the following:

<b>Sieve Size</b>	<b>Percent Passing</b>
25 mm	100
12.5 mm	95-100
4.75 mm	90-100
2 mm	70-100
75 Fm	15-70

**795.3 SOIL FERTILIZING MATERIAL:**

Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. All fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, mass and manufacturer's guarantee analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals or plants. It shall be delivered in unopened containers and shall have the chemical analysis as specified in the plans or specifications. Material which has become caked or otherwise damaged shall not be used.

**795.4 ORGANIC SOIL CONDITIONERS:**

In general, soil conditioners shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a pH not exceeding 7.5, and organic matter not less than 85%. Its gradation shall be such that at least 85% passes the 6.35 mm screen. In addition, it shall be treated with a non-toxic agent so as to be hygroscopic.

When manure is used as a soil conditioner, it shall be the product of yard fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be of a consistency that will readily spread with a mechanical spreader.

**795.5 CHEMICAL SOIL CONDITIONER:**

Chemical soil conditioners such as soil sulfur, gypsum or iron additive shall be commercially approved brands designated for agricultural use. Material which has become caked or otherwise damaged shall not be used.

**SECTION 795**

**795.6 SEEDS:**

Seeds shall be fresh, clean seeds, pre-mixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer's guaranteed analysis and germination percentage. They shall have a certificate or a stamp or a release accomplished by an agricultural commission.

**795.7 PLANTS, TREES, AND SHRUBS:**

**795.7.1 General:** All landscape stock shall be grown in nurseries approved by the State Department of Agriculture. They shall have a growth habit normal to the specie. Stock shall be sound, healthy, and vigorous; free from insect pests, sun scald, excessive bark abrasions and other objectionable disfigurements. They shall have normal, well-developed branch systems and vigorous, fibrous root systems which are neither root nor pot-bound and are free of kinked or girdling roots.

All stock shall have been grown in pots, cans, tubs, or boxes for a minimum of three months and a maximum of one year. They shall have sufficient roots to hold earth together after removal from the containers. This earth shall be free from noxious weeds including bermuda grass.

Stock shall be inspected and approved by the Engineer at the Contractor's storage site prior to delivery to the project.

**795.7.2 Flatted Plants:** Flatted plants shall be grown and remain in the flats until transported to the project site. The soil and spacing of the plants in the flats shall insure the minimum disturbance of the root system at transplanting.

**795.7.3 Trees:** Trees shall be of the specified height, spread and caliper and shall stand erect without support. The height shall be measured from the root crown to the last division of the terminal leader with the branches in a normal position and the caliper shall be measured 300 mm above the crown roots. For palm trees only, the height shall be measured from the ground line to the base of the growing bud.

**795.7.4 Shrubs:** Shrubs shall be of the specified type, height and spread. They shall be selected from high quality, well-shaped nursery stock.

**795.8 MISCELLANEOUS MATERIAL:**

**795.8.1 Headers and Stakes:** Lumber for landscaping shall be construction heart, rough-sawn redwood in the sizes specified; splicing will not be permitted. Stake used with header boards shall be 50 x 100 mm, pointed and at least 450 mm long.

**795.8.2 Tree Stakes:** Unless otherwise specified, tree stakes shall be 50 x 50 mm redwood posts, free of knots and reasonably straight, and of sufficient length to properly support the tree.

**795.8.3 Tie Wires:** Tie wire shall be No. 12 AWG zinc coated wire and the cover for this wire shall be 13 mm garden hose.

**795.8.4 Decomposed Granite:** Decomposed granite shall be as per Subsection 702.4 with the following exceptions. All material used for a specific project or location shall be from a single source and shall present a uniform appearance. The gradation shall be as shown below. If a specific color or type is required, it will be so indicated in the Contracting Agency's specifications.

Sieve Size	Percent Passing
19 mm	100%
12.5 mm	60-70
425 Fm	5-20

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End of Section

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