

CONSTRUCTION SPECIFICATIONS

FOR

CONTRACT 1999C071  
Golden Eagle Park Dam Improvements  
Fountain Hills, Arizona

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FEBRUARY 2000



(Engineer's Seal)

Prepared For

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Recommended by: \_\_\_\_\_ Date: \_\_\_\_\_

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Issued for Public Bidding by: \_\_\_\_\_ Date: \_\_\_\_\_

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SUPPLEMENTARY TO MARICOPA ASSOCIATION OF GOVERNMENTS UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION EDITION OF 1998 AND REVISIONS AND SUPPLEMENTS THERETO.

**GOLDEN EAGLE PARK DAM IMPROVEMENTS**

**SUPPLEMENTARY GENERAL CONDITIONS**

\*\*\* NOT APPROVED FOR CONSTRUCTION \*\*\*

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**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**GOLDEN EAGLE PARK DAM IMPROVEMENTS  
FOUNTAIN HILLS, ARIZONA**

**CONTRACT 1999C071  
PCN 6700331**

**SUPPLEMENTARY GENERAL CONDITIONS**

**SECTION 100 - GENERAL**

Titles and headings are for convenience of reference and have no bearing on the interpretation of these specifications.

When a publication is specified, it refers to the most recent date of issue, including interim publications, before the bid opening date for the Project unless a specific date or year of issue is provided.

In the contract, the words "or equal," referring to a product, material, or process, mean "equal as determined by the District."

In the contract, the words "as indicated" or "indicated" mean "as indicated or indicated on the contract plans."

**ADOPTED STANDARDS**

Except as otherwise amended by these Supplementary General Conditions and the Special Provisions, construction of this project shall be in accordance with all applicable MAG - Uniform Standard Specifications for Public Works Construction, latest edition, which are written and promulgated by the Maricopa Association of Governments. Copies of these documents, may be obtained at the Maricopa Association of Governments, 1820 West Washington Street, Phoenix, Arizona 85007.

Standards listed as "Reference Standards" in the various sections of these contract documents are hereby incorporated into this specification by reference.

Referenced documents shall include all revisions, amendments, supplements or addenda issued on or before the date of advertising for bids.

## PRECEDENCE OF CONTRACT DOCUMENTS

In case of a discrepancy or conflict, Project Plans will govern over the MAG Standard Specifications and Details; the Supplementary General Conditions and Construction Special Provisions will govern over the MAG Standard Specifications and Details; and the Project Plans, and Change Orders will govern over the Supplementary General Conditions, MAG Standard Specifications and Details and Project Plans.

## SECTION 101 - ABBREVIATIONS AND DEFINITIONS

### 101.2 - DEFINITIONS AND TERMS

1. Change the definition of the phrase "Board of Supervisors" to begin the Board of Directors acting under the authority of the laws of the State of Arizona and in their capacity of the Board of Directors of the Flood Control District of Maricopa County.
2. Change the definition of the phrase "Budget Project" to being a project financed by funds set aside in the annual budget or otherwise approved by the Flood Control District of Maricopa County.
3. Add to the definition of the phrase "Contract Documents", the phrase "Supplementary General Conditions".
4. Change the definition of the term "Engineer" to being the person appointed by the Flood Control District of Maricopa County Board of Directors to the office of Chief Engineer and General Manager for the Flood Control District of Maricopa County acting directly or through its authorized representative, the Chief of the Flood Control District of Maricopa County Construction and Maintenance Division.
5. Change the definition for the phrase "Notice of Award" to a letter from the Flood Control District of Maricopa County advising Contractor that it is the successful bidder and the Flood Control District of Maricopa County has accepted its proposal.

6. Change the definition of the term "Owner" to the Flood Control District of Maricopa County, acting through its legally constituted offices, officers, or employees.
7. Whenever the word "District" is used in these Specifications, it shall mean the Flood Control District of Maricopa County.
8. Add the definition of Maricopa County Minority Business Office (MBO); the office responsible of administering the Maricopa County Minority and Women Owned Businesses Enterprises Program.
9. Add the definition for the Maricopa County Minority and Women-Owned Business Enterprise Program as being the Program adopted by the Board of Supervisors.

## **SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS**

### **102.4 - EXAMINATION OF PLANS, SPECIAL PROVISIONS, AND SITE OF WORK**

Add the following:

The soil boring logs (included in the plan set) and Geotechnical reports, including ground water conditions, are available for review at the District, and Contractors are encouraged to do so.

As-built plans of the original dam construction including soil boring logs geotechnical profile of the dam and spillway are also available for review at the District, and Contractors are encouraged to do so.

Existing moisture conditions shall be no basis for claim for additional money or time extensions. The Contractor shall manipulate the existing soil as required to achieve stable soil conditions and the required densities, as well as safe and stable side slopes during construction activities.

### **102.5 - PREPARATION OF PROPOSAL**

Add the following:

Proposals, including the Bidding Schedule, must be legibly written in ink or typed, with all prices given in numerals. In case of a conflict between the unit bid price and the extension, the unit bid price will govern.

It shall be the responsibility of prospective bidders to determine, prior to submission of a bid, if any addenda have been issued by the Flood Control District. This may be accomplished by calling (602) 506-1501. Any addendum issued, if not already bound into the Special Provisions, must be attached and included as part of the Specifications and any quantities on the Bidding Schedule requiring change shall be adjusted to the new figure by pen and ink. Bids, which do not have appropriate addenda attached, show appropriate changes to the Bidding Schedule, and receipt of addenda acknowledged in the Proposal shall be invalid.

The bidder's Arizona State Contractor's License number and the classification under which it proposes to perform the work shall be shown on the proposal. An "A" General Engineering License is required for this contract. The two lowest bidders may be required to provide certification of prior satisfactory completion for similar construction and to furnish a copy of their license and the renewal certificate.

#### **102.6 - SUBCONTRACTOR'S LIST**

Add the following:

A list of subcontractors to be employed on the project shall be submitted with the bid, on the form provided in the Proposal. No change of the subcontractors named therein shall be made unless first approved in writing by Owner.

#### **102.7 - IRREGULAR PROPOSALS**

Add the following:

(f) If bidder fails to complete and submit the Maricopa County Minority and Women-Owned Business Enterprises Assurances Affidavit, the bid will be considered nonresponsive and rejected.

(g) If the bidder fails to acknowledge AND attach any addendum issued. If addendum is not already bound into the Specifications, the bid will be considered nonresponsive and rejected.

(h) If bidder fails to utilize Owner's bond forms, the bid will be considered nonresponsive and rejected.

- (I) If the entire specifications document is not returned.
- (J) If the Owner's provided Certificate of Insurance form is not utilized.

## **SECTION 103 - AWARD AND EXECUTION OF CONTRACT**

### **103.3 - AWARD OF CONTRACT**

Add the following:

The Contract shall be awarded on the Total Base Bid plus all Alternates. However, the Owner reserves the right to award or not to award any one or all of the Alternates.

### **103.6 - CONTRACTOR'S INSURANCE**

Add the following:

A statement from bidder's insurance carrier shall be included in the proposal certifying that it will furnish the specified kind and amounts of insurance to the bidder if it is awarded the contract. As required by law, the statement will be from an insurance carrier or carriers authorized to do business in the State of Arizona, or countersigned by an agent of the carrier authorized to do business in the State of Arizona. Concurrently with the execution of the contract, Contractor shall furnish a Certificate of Insurance using the included Certificate or one of equal wording, that names the additional insureds as set out in the Certificate. The Certificate shall also name the additional insureds as Certificate Holders. The types of insurance and the limits of liability shall be indicated on the included form.

#### **103.6.1(D) - CONTRACTOR'S INSURANCE**

Add the following:

Include additional insureds as indicated on the included Certificate of Insurance.

## **SECTION 104 - SCOPE OF WORK**

## PROJECT LOCATION

The proposed work is located in Maricopa County, within the Town of Fountain Hills. The site is approximately 30 miles northeast of Phoenix and can be reached by proceeding northeast on the Beeline Highway to Shea Blvd., east to Saquaro Blvd., north to Palisades Blvd., east to Golden Eagle Blvd. and north to Golden Eagle Park. The proposed work consists primarily of widening the existing emergency spillway, constructing a new auxiliary outlet works, extending the principal outlet works and raising the dam.

The average elevation of the project is above 1695 feet.

## WORK COVERED BY CONTRACT DOCUMENTS

The Work includes furnishing products, labor, tools, transportation, and services to construct the following major items:

- Widen the existing emergency spillway
- Construct a reinforced box culvert auxiliary outlet works and energy dissipater
- Raise the dam and modify the principal outlet works inlet structure
- Construct berms and floodwalls
- Construct erosion protection gabions and riprap below the emergency spillway, downstream of the principal and auxiliary outlet works within Ashbrook Wash and upstream of the dam within Cloudburst Wash
- Construct new chain link fence
- Construct masonry walls

## 104.1 - WORK TO BE DONE

### 104.1.1 - GENERAL

Add the following:

All water for construction purposes, drinking water, lighting, temporary electric power, heat and telephone service shall be arranged and provided for as per requirements of the work by Contractor at his expense.

### 104.2 - ALTERATION OF WORK

### **104.2.3 - DUE TO EXTRA WORK**

Add the following:

The Owner may at any time, by written order, and without notice to the sureties, if any, make changes within the general scope of this contract in any one or more of the following:

- A) Drawings, designs, or specifications;
- B) Method or manner of performance of the work;
- C) Owner-furnished facilities, equipment, materials, services, or site;
- D) Directing acceleration in the performance of the work.

Any other written or oral order from the Owner that causes a change shall be treated as a change order under this section provided that the Contractor gives the Owner written notification within two work days after receipt of such direction stating:

- A) The date, nature, and circumstances of the conduct regarded as a change;
- B) The particular elements of the contract performance for which the Contractor is seeking an equitable adjustment under this section, including any price or schedule adjustments;
- C) The Contractor's estimate of the time by which the Owner must respond to the Contractor's notice to minimize cost, delay, or disruption of performance.

The Contractor shall diligently continue performance of this contract to the maximum extent possible in accordance with its provisions. Except as provided in this section, no order, statement, or conduct of the Owner shall be treated as a change or entitle the Contractor to an equitable adjustment. If any change under this section causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, the Owner shall make an equitable adjustment and modify the contract in writing. The equitable adjustment shall not include increased costs or time extensions for delay resulting from the Contractor's failure to provide notice or to diligently continue performance. No proposal for the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

Add the following new section:

### **104.2.6 - COST ESTIMATES OR PRICE PROPOSALS**

The Contractor and any lower-tier subcontractors shall submit itemized cost estimates or price proposals for any owner-directed change order or Contractor-initiated claim.

Cost estimates or pricing proposals shall be itemized to include direct labor by man-hours, individual craft, hourly wage rate and verifiable labor burden. Other direct costs shall include rental and operator rates for rented or owned equipment, material trucking expenses and other costs clearly identified and directly allocable to contract performance. Material costs shall be itemized by item description, quantity for each item, unit price per item, including applicable sales tax markup, and extended total price per item. The Contractor shall provide copies of material supplier quote sheets, invoices or purchase orders, as appropriate.

Lump sum cost estimates or price proposals shall be rejected and returned to the Contractor for itemization as described above. Failure of the Contractor to submit properly itemized cost estimates or price proposals shall not constitute an excusable delay and will result in a change order being unilaterally priced at the Owner's fair estimated price.

Add the following new section:

#### **104.2.7 - VALUE ENGINEERING**

##### **A) General**

The Contractor is encouraged to voluntarily develop, prepare, and submit value engineering change proposals (VECP's). The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph F below. The Owner reserves the right to make alterations to the contract, in accordance with procedures elsewhere within this contract. Such alterations will not be eligible for inclusion in any VECP.

##### **B) Definitions**

Contractor's development and implementation costs means those costs the Contractor incurs on a VECP in developing, testing, preparing, and submitting the VECP as well as those costs incurred by the Contractor to make the changes required by the Owner's acceptance of the VECP.

Owner costs means those owner costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistical support. The term does not include the normal administrative costs of processing the VECP.

Instant contract savings means the estimated reduction in Contract cost of performance resulting from acceptance of the VECP, minus the allowable

Contractor's development and implementation costs, minus subcontractor's development and implementation costs (see paragraph G below).

Value engineering change proposal (VECP) means a proposal that (1) requires a change to the contract; (2) results in reducing the contract price or estimated cost without impairing essential functions or characteristics; and (3) does not involve a change in deliverable end item quantities, schedule, or a change to the contract type.

C) VECP Preparation

As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change affects contractually required schedule and cost reporting, it shall be revised to incorporate proposed VECP modifications. The VECP shall include the following:

- (1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effects of the change on the end item's performance. All design changes must be submitted on 24"x 36" standard drawing sheets along with supporting calculations. Each drawing sheet and at least the content sheet of the calculations shall be sealed by an Engineer registered in the State of Arizona.
- (2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revision.
- (3) A separate, detailed cost estimate for the affected portions of the existing contract requirements and the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph G below.
- (4) A description and estimate of costs the Owner may incur implementing the VECP, such as test and evaluation and operating and support costs. This is an estimate based only on the Contractor's understanding of additional efforts to be expended by the Owner, should the VECP be accepted. The final cost will be determined by the Owner.
- (5) A prediction of any effects the proposed change would have on collateral costs to the agency, i.e., costs of operation or maintenance.
- (6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved and previous Owner actions, if known.

D) Submission

The Contractor shall submit VECP's to the Owner's Engineer.

E) Owner Action

(1) The Owner will notify the Contractor of the status of the VECP within 15 calendar days after receipt from the Contractor. If additional time is required, the Owner will notify the Contractor within the 15-day period and provide the reason for the delay and the expected date of the decision. The Owner will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Owner will notify the Contractor in writing, explaining the reasons for rejection.

(3) The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Owner.

(4) Any VECP may be accepted, in whole or in part, by the Owner's award of a change order to this contract, citing this subsection. The Owner may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a change order incorporates a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Owner's decision to accept or reject all or any part of any VECP shall be final and not subject to disputes or otherwise subject to litigation.

F) Cost Sharing

(1) Rates. The Owner's share of savings is determined by subtracting the Owner's costs from instant contract savings and multiplying the result by 50 percent. The Contractor's share shall be the remaining 50 percent.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a change order to this contract to accept the VECP, reduce the contract price or estimated cost by the amount of instant contract savings, and provide the Contractor's share of savings by adding the amount calculated to the contract price.

G) Subcontracts

The Contractor may include an appropriate value engineering clause in any subcontract. In computing any adjustment in this contract's price under paragraph F above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Owner under this contract, but shall exclude any value engineering incentive payments; provided that these payments shall not reduce the Owner's share of the savings resulting from the VECP.

## **SECTION 105 - CONTROL OF WORK**

### **105.1 - AUTHORITY OF ENGINEER**

Add the following new section:

#### **105.1.1 - ENGINEER'S EVALUATION**

Engineer will be allowed ten (10) working days within which to evaluate each proposal or submittal made pursuant to subsections 105.3.1 and 106.4. Engineer will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. Engineer will record time required by Engineer and Engineer's Consultants in evaluating substitutes proposed or submitted by Contractor pursuant to subparagraphs 105.3.1 and 106.4(B) and in making changes in the Contract Documents (or in the provisions of any other direct contract with Owner for work on the project) occasioned thereby. Whether or not Engineer accepts a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer and Engineer's Consultants for evaluating each such proposed substitute item.

### **105.3 - CONFORMITY WITH PLANS AND SPECIFICATIONS**

Add the following new section:

#### **105.3.1 - SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES:**

If a specific means, method, technique, sequence or procedure of construction is shown or indicated and expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by Engineer will be similar to that provided in subparagraph 106.4(B).

## **105.5 - COOPERATION OF CONTRACTOR**

Add the following new section:

### **105.5.1 - PARTNERING**

The Owner intends to encourage the foundation of partnering relationship with the Contractor and its subcontractors. This partnering relationship will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objects are effective and efficient contract performance intended to achieve completion within budget, on schedule, and in accordance with plans and specifications.

The partnering relationship will be bilateral in makeup. Any cost associated with effectuating partnering will be covered by the Bid Item. The partnering workshop shall be scheduled after award of the contract, and prior to the Notice to Proceed, and shall be facilitated by a third party competent in the fundamentals of partnering, and mutually acceptable to Contractor and Owner. Follow-up workshops will be held periodically throughout the duration of the contract as agreed to by the Contractor and Owner.

An integral aspect of partnering is the resolution of disputes in a timely, professional and non-adversarial manner. Alternative dispute resolution (ADR) methodologies will be encouraged in place of the more formal dispute resolution procedures. ADR will assist in promoting and maintaining an amicable working relationship to preserve the partnering relationship. ADR in this context is intended to be voluntary, non-binding procedure available for use by the parties to this contract to resolve any dispute that may arise during performance.

Payment for Partnering will be made on the basis of paid invoices, and will be for a total amount not exceed the amount shown in the bid schedule for the item.

### **ITEM 105-1 - PARTNERING ALLOWANCE**

Add the following new section:

### **105.5.2 - PRE-CONSTRUCTION MEETING**

After award of the contract, a pre-construction meeting shall be scheduled at a location and time (prior to mobilization and start of construction) to be agreed upon between the Owner and the Contractor. The Contractor shall make all necessary arrangements to have key personnel of his company and of his principal subcontractors present at the meeting. Each representative shall have authority to make commitments and act for his firm. The purpose of the pre-construction meeting is to discuss any specific concerns or potential problems that the Contractor is aware of, to provide general information appropriate to the contract, to identify responsible individuals for various functions within each organization, and to develop tentative dates for the start of construction. There are submittals identified within the contract documents which are required to be prepared for the pre-construction meeting.

The Contractor shall be responsible to take minutes of the pre-construction meeting and distribute copies to all meeting participants. The meeting minutes shall be distributed within 48 hours of the meeting. At the subsequent construction progress meeting, the minutes will be attested or revised, as appropriate. The cost for attendance at the pre-construction meeting, and preparation and distribution of meeting minutes shall be incidental to the project and no extra payment will be made.

Add the following new section:

### **105.5.3 - CONSTRUCTION PROGRESS MEETINGS**

Construction progress meetings shall be scheduled weekly, or as considered necessary by the Owner. The Contractor shall make all arrangements to have key personnel of his company and of his principal subcontractors present at all progress meetings; representatives shall have authority to make commitments and act for their firms. The Contractor shall assume full responsibility to act for and commit any subcontractor employed by the Contractor, whether or not such subcontractor is represented at the meeting.

During the construction progress meeting the Owner's representative will act as chairman and will advise the Contractor of any administrative matters connected with the contract. The Contractor shall submit for review his two-week rolling

schedule. The Contractor's representative at these meetings shall be prepared to discuss and resolve construction problems and concerns, material delivery and vendor data submittals status, construction progress as measured against the Contractor's approved construction schedule and the Contractor's short range construction activities as provided on his two-week rolling schedule. The Contractor shall not be relieved of his responsibility to fulfill all of the terms of the contract as a result of any inferences drawn or suggestions made available at these meetings.

The Contractor shall be responsible to take minutes of the construction progress meetings and distribute copies to all meeting participants. The meeting minutes shall be distributed within 48 hours of the meeting. At the subsequent construction progress meeting, the minutes will be attested or revised, as appropriate. The cost for attendance at meetings, and preparation and distribution of meeting minutes shall be incidental to the project and no extra payment will be made.

#### 105.6 - COOPERATION WITH UTILITIES

Add the following:

An attempt has been made to determine the location of all underground utilities and drainage pipes, culverts, and structures; however, it shall be Contractor's responsibility to cooperate with the pertinent utility companies so that any obstructing utility installation(s) may be adjusted. Should Contractor's operations result in damage to any utility the location of which has been brought to its attention, he shall assume full responsibility for such damage. Contractor shall contact Arizona Blue Stake at (602) 263-1100 a minimum of two (2) working days before beginning any underground work. In addition, Blue Stake notification(s) shall be maintained on a current basis.

The following phone numbers should put Contractor in contact with the proper personnel:

<u>Name</u>	<u>Phone Number</u>
Blue Stake	(602) 263-1100
Chaparral City Water Co. - Jerry Blair	(480) 837-9522
Cox Communications - UTI	(602) 462-9844
Flood Control District - Tom Renckly	(602) 506-1501
Fountain Hills Sanitary District - Ron Huber or Bill Cunningham	(480) 837-9444

Name	Phone Number
Fountain Hills Unified School District - Rich Dobson	(480) 837-0690
Salt River Project Electric and Irrigation - Greg James	(480) 236-8143
Southwest Gas - UTI	(602) 462-9844
Town of Fountain Hills - Engineering - Jim Leubner	(480) 816-5141
Town of Fountain Hills - Traffic - Betty Brannan	(480) 837-2003
US West Communications - UTI	(602) 462-9844

### **105.7 - COOPERATION BETWEEN CONTRACTORS**

Is there a section to add here??

### **105.8 - CONSTRUCTION STAKES, LINES AND GRADES**

Replace with the following:

#### **GENERAL**

The Contractor shall furnish all materials, personnel, and equipment necessary to perform all surveying, staking, laying out of control lines and verifications of the accuracy of all existing control points which are delineated in the Contract Documents. The work shall be done under the direction of a Registered Land Surveyor licensed to practice in the State of Arizona.

The base surveys and cross sections of existing conditions are shown on the construction drawings and shall be used as basis of quantity determination.

The District will provide either traverse or control points for establishing an accurate construction centerline and will establish bench marks adjacent to this line for the proper layout of the work as described herein.

Traverse points, when provided, will be as follows:

For horizontal control, the District will run a traverse from which construction centerline can be established. The control points, delineated by iron pins, marks in concrete, or similar devices, will be located to minimize the likelihood of their destruction during construction activities. Coordinates of these points and/or ties to construction centerline will be provided.

For vertical control, the District will establish bench marks the entire length of the project at suitable intervals.

Traverse or control points set by the Engineer will be identified in the field to the Contractor.

## STAKING OUTLINE

Prior to beginning any survey operations, the Contractor shall furnish to the Engineer, for approval, a written outline detailing the method of staking, interval of stakes, marking of stakes, grade control for various courses of materials, referencing, structure control, and any other procedures and controls necessary for survey completion.

## FIELD BOOKS

The Contractor shall furnish field books to be used for recording survey data and field notes. These books shall be available for inspection by the District at any time and shall become the property of the District upon completion of the work.

## SURVEY CONTROL VERIFICATION

(A) Control Points (horizontal and vertical) - The existence and location of all survey monuments, bench marks and control points shall be verified prior to demolition or construction activity. Immediately notify the Engineer when location discrepancies greater than two-hundredths (0.02) foot horizontal or one-hundredth (0.01) foot vertical are found. All datum shall be Town of Fountain Hills.

(B) Control Lines - Construction control lines with grade breaks, transition points, horizontal and vertical curves, etc., shall be established and referenced prior to construction.

(C) Temporary Bench Marks - Temporary bench marks shall be established and referenced at this time.

## PRE-CONSTRUCTION LOCATION SURVEY

All existing features which are located prior to construction shall be referenced to survey monuments along control lines by stationing in accordance with the construction documents and by offset distance from the control lines. All features shall be relocatable after construction. Distances measured shall be within one-hundredth (0.01) foot.

(A) Survey monuments - All survey monuments that lie within the construction area that may be disturbed shall be referenced to a specific point on at least four (4) stable objects by distance measurement. Reference objects shall be located no greater than three-hundred (300) feet from the survey monument being referenced.

(B) Water and Sewer line appurtenances - Water and sewer line surface appurtenances such as manholes, valves and cleanouts that lie within the construction area shall be located and noted on the Contractor's approved construction documents prior to any demolition or excavation.

(C) Match Points and Removals - Verify the location (horizontal and vertical) of existing facilities to which the project connects. Immediately notify the Engineer when location discrepancies of connecting facilities greater than one-tenth (0.10) foot horizontal or two-hundredths (0.02) foot vertical are found.

## CONSTRUCTION STAKES

The Contractor shall set construction stakes and marks establishing lines and grades for spillway excavation, dam embankment, concrete structures, walls, riprap and shotcrete lining, channels, roads, sidewalks, curbs, centerlines for utilities and necessary appurtenances and other work as indicated in the Contract Documents and shall be responsible for their conformance with the plans and specifications.

The stakes shall be established in accordance with the following guidelines which represent the minimum standard and the Contractor shall provide additional stakes and controls necessary to perform the work. The Contractor shall be held responsible for the preservation of all stakes and marks and shall replace, at no additional cost to the District, any construction stakes or marks which have been carelessly or willfully destroyed by any party.

(A) Dam embankment:

(1) Subgrade stakes shall be set to subgrade elevation at twenty five (25) foot intervals. Stakes shall be set at centerline, toe of slope, daylight lines and at grade break lines. Stakes shall also be set at the centerline and ends of spillways. Quarter

lines shall be staked where the distance between the top and bottom of the slope exceeds twenty (20) feet.

(2) Riprap invert finish grade stakes shall be set at the centerline and each edge at 50 foot intervals.

(3) Cut sheets shall be supplied to the Contractor and District Inspector.

(B) Storm Sewer and Drainage: All cuts shall be to the invert of the pipe or the foundation elevation, given to the nearest one-hundredth (0.01) of a foot.

(1) Stakes for storm sewer shall be driven flush with the existing ground, set on an offset at fifty (50) foot intervals. Stakes shall be marked with the offset and indicated cut.

(2) Cut sheets shall be supplied to the Contractor and District Inspector.

(C) Concrete Box Culverts:

(1) Cut stakes for Box Culvert floor slab subgrade excavation shall be driven flush with the existing ground, set on an offset at twenty five (25) foot intervals. Stakes shall be marked with the offset and indicated cut given to the nearest one - hundredth (0.01) of a foot.

(2) Blue top grade stakes for Box Culvert floor slab ABC shall be set at grade on a 2 - foot offset, each side of the slab, at twenty five (25) foot intervals.

(3) Two line and grade stakes at ten (10) foot intervals shall be placed on the centerline extension of each wingwall. Stakes shall be marked with the offset and indicated cut to the top of wall and top of footing.

(D) Concrete Structures:

(1) Cut stakes for floor slab subgrade excavation shall be driven flush with the existing ground, set on an offset at twenty five (25) foot intervals. Stakes shall be marked with the offset and indicated cut given to the nearest one-hundredth (0.01) of a foot.

(2) Blue top grade stakes for floor slab ABC shall be set at grade on a 2-foot offset, each side of the slab, at twenty five (25) foot intervals.

(3) Two line and grade stakes at ten (10) foot intervals shall be placed on the centerline extension of each wingwall. Stakes shall be marked with the offset and indicated cut to the top of wall and top of footing.

(E) Walls: All cuts shall be to the foundation elevation, given to the nearest one-hundredth (0.01) of a foot.

(1) Stakes for walls shall be driven flush with the existing ground, set on an offset at twenty five (25) foot intervals. Stakes shall be marked with the offset and indicated cut.

(2) Cut sheets shall be supplied to the Contractor and District Inspector.

#### RE-ESTABLISHMENT SURVEY

Monument locations shall be marked with "straddlers" (four nails with metal "shiners") driven into the pavement, placed in pairs approximately six feet apart and opposite to each other. Lines connecting opposing pairs shall form a ninety degree cross with three foot legs. The center of the cross shall signify the exact location of the center of the monument to be set. Monuments shall be drilled or punched after they have been set.

Manhole locations shall be painted on the pavement.

#### INSPECTION AND ACCEPTANCE OF WORK

The District reserves the right to make inspections and random checks of any portion of the staking and layout work. If, in the District's opinion, the work is not being performed in a manner that will assure proper control and accuracy of the work, the District may order any or all of the staking and layout work redone at no additional cost to the District.

#### MEASUREMENT AND PAYMENT

Construction surveying will not be measured for payment and the cost shall be included in the other items of work.

#### AS-BUILTS

The Contractor shall maintain a marked up full-size set of plans on-site that accurately reflects field adjustments, modifications, changes, etc. current through the end of each week. This field set of plans shall be used by the Contractor's surveyor to incorporate all the final as-built information at the completion of the project. The District inspector will check site as-builts on a weekly basis to insure all modified project elements have

been properly recorded on the field plan set. Retention of the Contractor's payment will result if this field set is not kept current through the end of each weeks work. The District's inspector will advise the Engineer prior to each progress payment whether the as-built set is acceptable and complete.

All work included in the contract documents as well as changes to the contract shall be noted as correct or modified by either checking off the information if it is correct, or by drawing a neat line through the original data and writing in the correct information if the information is incorrect. Unless noted otherwise below in the minimum as-built requirement section, station/offset measurements will be from construction centerline/monument line both parallel and transverse to dam or spillway; added items or location changes shall be physically drawn at revised or new locations on the as-builts; and all measurements and stations shall be to the nearest tenth of a foot.

The minimum requirements for as-built acceptance is as follows:

1. Project Drawing Quantity Notations: Any project drawing or quantity summary sheet that shows a quantity on it that is incorrect shall be corrected by drawing a neat line through the original quantity and writing in the correct information. When space on the drawing does not allow room to indicate the corrections, a separate table may be drawn on a separate sheet with reference on both plan sheets to the plan sheet that the table refers to or to the sheet where the table is located.
2. Existing/New Utilities: All underground infrastructure utilities, whether depicted on the project plans or not, shall be verified, corrected or added to the as-builts noting the beginning and ending station/offset location and elevation of utility relative to finished dam or spillway grade or other identifiable ground or permanent project feature.
3. Removals: Dimensions and/or other volumetric descriptions and station/offset location of all removed items.
4. Landscaping and Irrigation: Note beginning and ending station/offset/elevation including size of pipe; sleeve / pull-box / electrical-valve / water-service / tap / meter / bubbler / drip-line locations.
5. Box Culverts and Other Structures: Station/offset distances/centerline-bearing line/finished elevations of all structure elements.
6. Linear Items: Fences, walls, ditches, etc. shall be located by station/offset and tied in with a permanent point. Footing and top of wall elevations shall be shown of plan or profile.
7. Dam: Elevations of top of fill, foundation elevation for structures, stripping and benching elevations for embankment raise, top of dam / crest of dam profile, elevations and locations of any exposed rock, thickness and limits of rock, sand, clay or earth fill.
8. Spillway: Final cross sections and profile of excavated spillway, elevations of footings and top of wall, locations and quantity of dental concrete. Locations and thickness of erosion protection.

The as-built drawings shall be certified by an Arizona Registered Land Surveyor. As-built drawings shall be delivered to the Engineer within thirty (30) days from the date of final inspection and acceptance by the District of the work completed under this contract. Final payment will be made only after submitted as-builts are accepted by the District.

## MEASUREMENT AND PAYMENT

As-builts will not be measured for payment and the cost shall be included in the other items of work.

## SECTION 106 - CONTROL OF MATERIALS

### 106.1 - SOURCE OF MATERIALS AND QUALITY

Add the following:

Select Material, Aggregate Base, Mineral Aggregate, concrete, steel products and pipe shall be obtained from commercial sources. Contractor shall pay all royalties or any other charges or expenses, incurred in connection with the securing and hauling of the material. Contractor is required to furnish Engineer with a list of its proposed commercial sources prior to use, and shall present certificates stating that the material produced from any commercial sources is in accordance with the Uniform Standard Specifications and these Supplementary General Conditions and Special Provisions.

### 106.4 - TRADE NAMES AND SUBSTITUTIONS

Replace with the following:

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quantity required. Unless the specification or description contains or followed by words reading that no like, equivalent or "or-equal" item of material or equipment of other Suppliers may be accepted by Engineer under the following circumstances.

A) "Or-Equal": If in Engineer's sole discretion and item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by

Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

B) Substitute Items: If Engineer's sole discretion and item does not qualify as an "or-equal" item under subparagraph 106.4 (A), it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and acceptable substitute therefor. The procedure for review by Engineer will include the following and may be supplemented in the Special Provisions and as Engineer may decide is appropriated under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor. If Contractor wishes to furnish or use a substitute item of material or equipment, Contractor shall first make written application to Engineer for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any to which the evaluation and acceptance of the proposed substitute will; prejudice contractor's achievement of completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for work on project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish additional data about the proposed substitute.

Contractor's Expense: All data to be provided by Contractor in support of any proposed "or-equal" or substitute item shall be at Contractor's expense.

## **SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC**

### **107.1 - LAWS TO BE OBSERVED**

Add the following Paragraph (G):

(G) Contractor shall comply with Sections 103 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-330) as supplemented by Department of Labor Regulations (29 CFR Part 5). Contractor shall also comply with all applicable provisions of the Americans with Disabilities Act (Public Law 101-336, 42 U.S.C. 12101-12213) and all applicable federal regulations under the Act, including CFR Parts 35 and 36.

## **107.2 - PERMITS**

Replace with the following:

Contractor shall obtain all permits and licenses., pay all charges, fees, taxes and provide all notices necessary and incidental to the due and lawful prosecution of the work. Contractor shall obtain a Maricopa County Dust Control Permit.

Add the following new section:

### **107.2.1 - NPDES PERMIT REQUIREMENTS**

Add the following:

A. This project is subject to the National Pollutant Discharge Elimination System (NPDES) Stormwater requirements for construction sites under the Environmental Protection Agency (EPA) General Permit for Arizona. Under provisions of that permit, the Contractor shall be designated as permittee, and shall take all necessary measures to assure compliance with the NPDES General Permit for Arizona as well as all other applicable Federal, State and local laws, ordinances, statutes, rules and regulations pertaining to stormwater discharge. As the permittee, the Contractor is responsible for preparing, in a manner acceptable to the EPA, all documents required by this regulation, including but not necessarily limited to:

1. Stormwater Pollution Prevention Plan (SWPPP) for the project, including certification of compliance form. Contractor shall be required to develop, implement, update and revise the SWPPP, as necessary, in order to assure compliance with the EPA permit requirements. The SWPPP shall be retained on the project site at all times during construction.
2. Notice of Intent (NOI) to assure compliance with the NPDES General Permit for Arizona, including certification of signatures.
3. Notice of Termination (NOT) of coverage under NPDES General Permit for Arizona.

B. Preliminary copies of the NOI and the SWPPP shall be submitted to Owner during the preconstruction meeting and shall be subject to review by Owner prior to implementation.

C. Contractor shall submit the completed and duly signed NOI forms no later than forty-eight (48) hours prior to the initial start of construction on the project to the following agencies:

EPA Stormwater Notice of Intent  
P.O. Box 1215  
Newington, VA 22122

A copy of the completed NOI form shall be submitted to the following:

Stormwater Coordinator  
Arizona Department of Environmental Quality  
P.O. Box 600  
Phoenix, AZ 85001-0600

Maricopa County, Current Planning  
Planning & Development Division  
301 West Jefferson, Third Floor  
Phoenix, Arizona 85003  
(602) 506-3301

Failure by the Contractor (or subcontractors of any tier) to submit NOI's within the mandated time frame shall result in delay of the construction start date, and no claim for extension of time will be granted for such delay. A copy of the completed NOI shall be posted at the construction site.

D. Inspections of all stormwater pollution control devices on the project shall be performed by Contractor on a monthly basis and following each rainfall of 0.50 inches or more in a 24-hour period at the project site as required under provisions of the NPDES General Permit for Arizona. Contractor shall prepare reports on such inspections and retain the reports for a period of three years following the completion of the project. Inspection reports shall be submitted monthly to Owner along with progress payment requests. Additionally, Contractor shall maintain all stormwater pollution control devices on the project in proper working order, which shall include cleaning and/or repair during the duration of the project.

E. Contractor warrants that its employees and subcontractors of any tier and their employees shall at all times comply with all applicable laws, ordinances, statutes, rules and regulations set forth by all federal, state and local governments and the Environmental Protection Agency in connection with NPDES Permitting

requirements and laws and regulations pertaining to air, groundwater and surface water quality.

Fines and penalties imposed by the EPA against Owner or the Contractor, for Contractor's failure to comply with any of the requirements of NPDES General Permit of Arizona, shall be borne by the Contractor.

F. Upon project completion, acceptance and demobilization, Contractor shall submit its completed, duly executed NOT form to the EPA, with a copy to the Arizona Department of Environmental Quality (and the appropriate municipality), at the address listed in Section (B) above, thereby terminating all NPDES permit coverage for the project. Contractor shall then surrender to Owner copies of the SWPPP, inspection information and all other documents prepared and maintained by the Contractor in compliance of the NPDES General Permit. Contractor shall retain the originals of such documents for a period of three (3) years following the completion of the project.

G. The Lump Sum price for the SWPPP shall include all material, labor, and all other costs relating to the preparation, installation and maintenance of the SWPPP during project construction, including assuring proper operation of the pollution control devices installed, and all maintenance, cleaning, and disposal costs associated with clean-up and repair following storm events, runoff or releases on the project. The Lump Sum price for the SWPPP shall be inclusive of all costs, and no additional claims shall be made by Contractor under any other specification provision of these documents, including Change Conditions. Payment for this bid item shall be upon final completion and acceptance of the project, as per Section 109.1.

H. Copies of all required forms and guidance for preparing the SWPPP are available in the "Drainage Design Manual for Maricopa County, Volume III Erosion Control". The manual is available at the Flood Control District, 2801 West Durango Street, Phoenix, Arizona 85009.

Payment for NPDES / SWPPP permit requirements shall be made on the basis of lump sum for all work described in Subsection 107.2.1 for:

#### **ITEM 107-1 - NPDES / SWPPP**

Add the following new section:

#### **107.2.2 - OTHER PERMITS**

The following permits have been obtained by the Owner for the construction of the dam. The Contractor shall follow all terms and conditions of each permit as they apply to his operations.

#### STATE 401 WATER QUALITY CERTIFICATION

The Corps of Engineers and the Arizona Department of Environmental Quality have determined that this project requires a Section 401 permit. Contractor shall follow all the requirements in the 401 Water Quality Certification permit. The permit will be attached to the bid documents.

#### US ARMY CORPS OF ENGINEERS, 404 PERMIT

The Corps of Engineers has determined that this project requires a permit under Section 404 of the Clean Water Act. Contractor shall follow all the requirements in the permit. The permit will be attached to the bid documents.

#### ADWR TEMPORARY DEWATERING PERMIT

The Arizona Department of Water Resources has determined that this project requires a temporary dewatering permit. Contractor shall follow all the requirements in the permit. The permit will be attached to the bid documents.

#### ADWR DAM CONSTRUCTION PERMIT

The Arizona Department of Water Resources has determined that this project is under the jurisdiction of the Division of Safety of Dams and any construction requires a permit. All plans, specifications, addendums, plan and specification changes and Value Engineering changes will be reviewed by ADWR. The Contractor shall follow all the requirements in the permit. The permit will be attached to the bid documents.

#### 107.4 - ARCHEOLOGICAL REPORTS

Add the following:

Any cultural and/or paleontological resource (historic or prehistoric site or object) discovered by the Contractor, or any person working on his behalf, shall be immediately reported to the Engineer. The Contractor shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Engineer. An evaluation of the discovery will be made by authorized personnel and the Engineer to determine appropriate actions to prevent the loss of significant cultural or scientific resources.

#### **107.5 - SAFETY HEALTH AND SANITATION PROVISIONS**

Add the following:

The entire construction site shall be considered a "Hard Hat Area" and all personnel in the area will be required to wear a hard hat.

#### **107.5.2 - COMPLIANCE WITH THE ARIZONA COMMUNICATION STANDARD**

Add the following:

Owner will provide Contractor with Material Safety Data Sheets (MSDS) for any products known to exist on the site that are deemed health hazards. Contractor shall provide a copy of Owner-provided MSDS to all subcontractors.

Contractor will provide Owner and all subcontractors with MSDS for any products that have or are deemed health hazards that will be brought onto the site or created on the site by either Contractor or by any subcontractors.

Contractors will provide Owner with a statement certifying that all personnel (Contractor and subcontractor) employed by Contractor or by a subcontractor on the job site have received the required Hazard Communication Standard training.

#### **107.6 - PUBLIC CONVENIENCE AND SAFETY:**

add the following to the MAG Standard Specifications:

The Contractor shall abide by all OSHA 29 CFR Part 1926 and 29 CFR Part 1910 Regulations, as well as all applicable standards of the Environmental Protection Agency (EPA), the Arizona Department of Environmental Quality (ADEQ). The

Contractor shall maintain a copy of the specified OSHA Standards on the construction site at all times.

*The Contractor shall submit a Safety Plan at the preconstruction conference.*

The Safety Plan shall specify the procedures the Contractor will implement to satisfy OSHA and any state occupational safety guidelines related to the worker as well as the public in the construction of excavations, structures and confined air spaces along with all other activities involved in the project. The Engineer will review the Safety Plan within 10 working days and identify any additional elements of the project to be included. The Contractor shall then modify the Safety Plan, if necessary, for re-submittal to the Engineer within 5 working days. The Contractor shall not commence work until the Safety Plan has been approved, unless authorized by the Engineer.

The safety plan shall include a list of emergency procedures, phone numbers, and methods of communication for medical facilities, Police, Fire Department, and other emergency services which may become necessary. The Contractor shall be responsible for providing First Aid treatment and medical supplies on the project site, in accordance with OSHA 29 CFR Part 1910, and for producing and maintaining records of any injury-related incidents. The Safety Plan shall include the requirement that all workers must wear OSHA approved hard hats, reflective safety vests or other approved high visibility warning garments, work shoes, and, when appropriate, safety glasses while in construction areas. The Engineer and Project Superintendent shall each ensure that their visitors comply with the above requirements as appropriate.

The Contractor shall designate a competent person as Safety Supervisor to be responsible for implementation of the Safety Plan throughout the contract period. The competent person shall be capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and have authority to take prompt corrective measures to eliminate them. The Safety Supervisor shall also conduct safety meetings, oversee and maintain safe job-site conditions, and ensure that emergency procedures, phone numbers, and all applicable OSHA notification posters are conspicuously placed in all work areas.

The safety Supervisor shall maintain records demonstrating that all workers have sufficient experience to operate their equipment, and have been instructed in the proper operation of the equipment. The Safety Supervisor shall furnish evidence that crane operators have been instructed in accordance with the requirements of OSHA 29 CFR Part 1926.550 Subpart N, and 1926.955 Subpart V.

No measurement or separate payment will be provided for jobsite safety, the work being considered a subsidiary obligation of the contract.

## **107.6.1 - CONTRACTORS MARSHALING YARD**

Add the following:

The Contractor shall obtain approval of the Engineer when using ADOT or other vacant property to park and service equipment and store materials for use. The Contractor will obtain prior written approval of the property owner for such use and submit a copy of the approval to the Engineer prior to use of the property.

The Contractor shall grade all construction yards, easements and limits of construction which are disturbed by construction or construction related activities to the lines and grades shown on the plans; or as a minimum, where no line or grade is shown, to a condition similar to or better than the pre-existing condition.

Add the following new section:

### **107.6.3 PUBLIC INFORMATION AND NOTIFICATION:**

The Contractor shall employ a specialty public information service as a subcontractor to provide the community relations program for the project as described herein. The name and address of the public information subcontractor shall be submitted with the bid as specified in subsection 102.6 of the Supplementary General Conditions. Contractor shall work closely with his subcontractor in developing and carrying out the community relations program, but shall not expect to actually perform the work of providing the public information services. Contractor shall submit a history of the subcontractor's qualifications and experience in public information services at the pre-construction conference for acceptance by the Engineer. The community relations program shall be designed to run the full length of calendar days in the contract for this project. The program will include but not be limited to:

1. Distributing a preconstruction information letter to all residents, business, schools, etc. for the area within one-quarter mile of the project limits.
2. Printing and distribution of public notices and/or newsletters.

The Contractor will use these or other means to inform the local citizens of necessary operations which create high noise levels, street closures, limited access, detour locations, haul route and material delivery routes, hours of construction and disruption of bus, trash, school bus and other delivery/pick-up routes.

The Contractor will be required to furnish a private line telephone to be used solely for receiving incoming calls from local citizens with questions or complaints concerning construction operations or procedures. The Contractor shall publish this phone number and maintain a 24-hour answering service. The answering service shall be operated by Contractor personnel during all hours that work is being performed on the job site. The Contractor shall maintain a log of incoming calls, responses, and action taken which shall be submitted to the Engineer weekly and/or upon request.

Prior to the start of work, the Contractor shall notify, by letter, all affected businesses and residents of construction plans and schedules within the geographic area identified above. In addition, all schools and emergency services which serve the geographic area will also be notified even though they may be located outside the geographic area described above. The letter shall contain, as a minimum, the following information:

1. Name of Contractor
2. 24-hour telephone complaint number
3. Brief description of the project
4. Name of Contractor project Superintendent
5. Name of Engineer
6. Name of area supervisor
7. Construction schedule including anticipated work hours
8. Traffic regulations including lane restrictions

The Contractor shall submit a Public Information and Notification Plan to the Engineer at the pre-construction meeting. No payments shall be made for this item until the Engineer approves the plan.

The plan and work which is eligible for reimbursement shall include: meetings with impacted businesses, schools, emergency services, residents, etc.; scheduling; preparation and distribution of newsletter at least monthly; and maintaining a 24-hour telephone hot line for complaints.

The Contractor shall submit a final report / evaluation of the Public Information and Notification process performed for this project. This report shall be submitted before the Contractor receives final payment.

Payment will be based on invoices, and will be for a total amount not to exceed the amount shown in the bid schedule for the item, "PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE", for work performed in notifying and coordinating with the local population impacted by this project. To cover the cost for administration and supervision, the General Contractor may add an amount equal to not more than 5 percent of the accumulated total invoiced billing for actual public information services provided by a Subcontractor. This cost for administration and

supervision will be considered included in the "PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE".

**ITEM 107-2 - PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE**

Add the following new section:

**107.6.4 - PROJECT SIGNS:**

Contractor shall provide and install 4 project information signs, at locations to be determined by the Engineer, before beginning construction to inform the public of the forthcoming project, construction dates, and suggested alternate travel routes. Project signs shall include the names of all agencies participating in the project. The signs shall also include the 24-hour hot line complaint telephone number. Signs shall be constructed in accordance with the "Project Sign Information" drawing to be provided to the Contractor at the pre-construction meeting. The signs shall be installed at the location(s) approved by the Engineer. The Contractor shall maintain the signs as necessary, and update the information as requested by the Engineer. The signs shall be as 4' x 8' in dimension. Text shall be Forest Green on a white background. The District logo will be supplied by the District. The sign shall be as shown in the sample below. For further information, contact Mr. Fred Fuller at (602) 505-1501.



Payment shall be made according to the allowance in the Bidding Schedule in installments of 50% upon installation, and the remaining 50% upon final payment for the work.

## ITEM 107-3 - PROJECT SIGNS ALLOWANCE

### 107.7 - BARRICADES AND WARNING SIGNS

add the following to the MAG Standard Specifications:

Key barricade points are to be indicated on the construction plans or on a traffic control plan submitted by the contractor for approval before work begins.

### 107.9 - PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE

add the following:

The Contractor shall limit all construction activities to the right-of-way and TCE limits shown on the plans and shall not disturb any areas other than as required for construction as shown on the plans.

The Contractor shall grade and restore all Temporary Construction (TCE) and Permanent Easement areas, and project areas which are disturbed during construction to the lines and grades shown on the plans, or as a minimum, where no lines and grades are shown, to a condition similar to or better than the pre-existing condition.

The Contractor shall restore the area of all temporary drain locations to as good as or better than pre-existing conditions, including backfilling any temporary ditches and removing any temporary berms and pipes.

Under no circumstances shall the disposal of debris from construction operations create a blemish on the landscape. Material which is to be stockpiled or disposed of off-site shall not encroach on running or intermittent streams, or other waters of the U.S. unless the Contractor has obtained the appropriate permits in accordance with applicable state and federal regulations.

### SITE ACCESS ROAD SUITABILITY, INSPECTION, AND RESPONSIBILITY FOR REPAIR

Site access is via Town roads. Prior to heavy haul traffic, the Engineer, Contractor and Town shall jointly perform a condition survey of the road(s). Subsequent

damage to the road(s) which can be attributed to construction traffic shall be repaired by the contractor as specified on the plans and the specifications.

#### PROTECTION AND REPAIR OF EXISTING FACILITIES.

Existing improvements such as retaining walls, steps, railings, picnic tables, underground utilities, landscaping, lighting and other facilities within or adjacent to the construction limits are to be marked or otherwise protected from construction activities. Facilities are not to be used for storage, stacking or blocking and are to be protected from staining and breakage. Town and School District assistance in locating existing facilities, including underground utilities, is available upon request. Public utilities shall be located by requesting "Blue Stake" service.

#### CONSTRUCTION AREA MAINTENANCE AND CLEANUP

All construction areas, including parking and storage areas, are to be kept free of trash and litter by regular removal from the site or by placement in containers provided for such purpose for later disposal by the contractor.

Excess deleterious substances (such as oil, fuel, cementitious residue, bitumens, curing compounds) from spills or construction operations shall be promptly cleaned up and disposed. Special care is to be taken to keep such substances out of the lake and from areas where gravity or storm runoff might carry them to the lake or a natural drainage. All cementitious residue, including that from equipment wash down, is to be placed in sealed bottom containers made for such purpose and removed from the project. Pavement is to be protected from oil staining by use of cat litter, drip pans or similar means.

For final cleanup of construction operations in construction zones and work areas: remove all rubbish, trash, litter, and material placed for protection of facilities. Remove and dispose of any soil containing petroleum products or cementitious residue; restore soil removal areas with imported natural material if necessary. Clean petroleum products from pavement. Sweep or wash pavement. Remove other stains, spills and foreign deposits due to construction operations. Fill ruts and restore natural ground surfaces outside the limits of permanent constructed features. Rake or otherwise groom grounds that are neither paved or planted to provide a natural appearance that matches adjacent undisturbed areas.

Final cleanup is to be approved by the Engineer.

## **107.10 - CONTRACTOR'S RESPONSIBILITY FOR WORK**

Add the following:

Contractor is advised that the work will be subject to flows of water of varying amounts. Owner assumes no responsibility for notifying Contractor of any anticipated flows, nor for any damages incurred by Contractor to its equipment or to any of the Contractor's work as result of any flows of water.

## **107.18 - CONTRACTOR'S RESPONSIBILITY FOR WORK**

The Contractor shall implement the requirements of the National Pollutant Discharge Elimination System (NPDES) for erosion control due to storm water runoff during construction, as specified above in Subsection 107.2.1.

Until final written acceptance of the project by the Engineer, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof by the action of the elements, or from any other cause, whether arising from the execution or from the nonexecution of the work. The Contractor shall rebuild, repair, restore and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance. No reimbursement shall be made for work necessary due to the Contractor's failure to comply with the requirements of the SWPPP.

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

## **107.19 - DAMAGE BY STORM, FLOOD OR EARTHQUAKE**

Contractor is advised that part of the work will be done in Ashbrook Wash and may be subject to flows of water of varying amounts. Owner assumes no responsibility for notifying Contractor of any anticipated flows in these features, nor for any damages incurred by Contractor to its equipment or to any of the Contractor's work as a result of any flows of water, except as described below:

**Blockage of the 60" concrete pipe principal outlet due to equipment, material stockpiles or other reasons will not be allowed at any time. A minimum width of xxx feet at the emergency spillway crest and xxx feet within the emergency spillway channel must be kept clear at all times.**

The Contractor shall be responsible for controlling and handling stormwater and other flows throughout the construction site, both surface drainage and channel flows, except as described below.

Attention is directed to Subsection 107.18, "Contractor's Responsibility for the Work". In the event damage to the work is caused by a storm, flood, or earthquake which constitutes an "Occurrence," as hereinafter defined, the provisions of this subsection shall be applicable and the Contractor may apply in writing to the Engineer for the District to pay or participate in the cost of repairing damage to the work from such cause or, in lieu thereof, and at the sole discretion of the District, terminate the contract and relieve the Contractor of further obligation to perform the work, subject to the following:

(A) Occurrence

"Occurrence" shall include tornadoes; earthquakes; storms and floods for which the Governor has proclaimed a state of emergency; or other catastrophic, unusual, sudden, and unforeseeable manifestations of the forces of nature, the effect of which could not have been prevented or minimized by reasonable human foresight and effort. **An "occurrence" shall also include emergency spillway flows which exceed 1 foot deep at the emergency spillway crest. This corresponds to the approximate maximum water level of the runoff from a xx year recurrence interval rainfall with xxxx of the width of the spillway crest blocked.** An "occurrence" shall only be considered when the damaged work is located within the territorial limits to which such proclamation is applicable.

(B) Application by Contractor

The Contractor shall immediately begin performing emergency work necessary to provide for the safety and passage of public traffic, and such other emergency work necessary to mitigate damages to the facilities. The Contractor's written request for the District to pay or to participate in the cost of rebuilding, repairing, restoring or otherwise remedying the damage to the work caused by the occurrence shall be submitted to the Engineer. The repair work may begin prior to authorization by the Engineer, but the Contractor shall keep accurate costs of all such work performed.

(C) Repair Work

Repair of damaged work under the provisions of this subsection shall be pursuant to a supplemental agreement issued hereunder and specifying the repair work to be performed on the damaged facility. Such repair work shall consist of restoring the

in-place construction (for the purposes of this subsection erected falsework and formwork shall be considered in-place construction) to the same state of completion to which such work had advanced prior to the Occurrence. Emergency work which the Engineer determines would have been part of the repair work if it had not previously been performed, will be considered to be part of said repair work. The District reserves the right to make changes in the plans and specifications applicable to the portions of the work to be repaired, and if such changes will increase the cost of repairing the damage over the Engineer's estimate of the cost of repair without the changes, the Contractor will be paid for such increased costs in accordance with Subsection D.

Nothing in this section shall be construed to relieve the Contractor of full responsibility for the risk or injury, loss or damage to materials not yet incorporated in the work and to materials, tools, and equipment (except erected falsework and formwork) used to perform the work, nor to relieve the Contractor of his responsibility under Section 3.18 – "Indemnification" of the General Conditions of the contract." The District will be responsible for any portion of the work accepted by the Engineer in accordance with Section 9.8 – "Substantial Completion" of the General Conditions of the contract.

(D) Determination of Costs

Unless otherwise agreed between the Engineer and the Contractor, the cost of the work performed pursuant to this Subsection will be determined in accordance with the provisions specified in Subsection 109.04 - Force Account Work. The cost of emergency work, which the Engineer determines would have been part of the repair work if it had not previously been performed, will be determined in the same manner as the authorized repair work.

(E) Payment for Repair Work

The District will pay the cost of the repair work as determined in Subsection D.

(F) Termination of Contract

If the District elects to terminate the contract, the termination and the determination of the total compensation payable to the Contractor shall be governed by the provisions of the contract and the General Provisions.

**107.20 - DIVERSION AND CARE OF WATER**

## DESCRIPTION

This section covers the work necessary for diversion of surface and subsurface flow around the construction areas, and handling and removal of all other water during the entire construction period, complete, including related appurtenances.

## DATA

Estimated xx year recurrence interval runoff hydrographs for a xx month period have been prepared by the DISTRICT from data collected at the dam. The data is plotted graphically and presented in Figures 1. This data may be used to estimate flooding risk during construction, however, the Contractor is advised that he shall make his own determination of risk based on this and other data and mitigate that risk accordingly. **Get this from Kathryn Gross**

Figure 1 - xx year discharge

## PLAN

The diversion and care of water plan shall address the handling and removal of water from all sources. Design, construction, implementation, and operation of the diversion and care of water plan is the sole responsibility of the Contractor. Water shall be removed so work can be performed in the dry without damage to foundation soils. Prior to beginning any work on diversion and care of water from worksite excavations and foundations, the Contractor shall submit the plan for approval by the Engineer. The plan shall show the proposed method for diversion of surface water from around the construction site and protection of the site from surface water and all other water during construction; dewatering; and removal of water from excavation and foundations.

## CODES, ORDINANCES, AND STATUTES

Contractor shall familiarize himself with, and comply with, all applicable codes, ordinances, and statutes and bear sole responsibility for penalties imposed for noncompliance.

## DIVERSION, DEWATERING AND REMOVAL

The Contractor shall provide all labor, materials, and equipment necessary to accomplish the work specified in this section.

The Contractor shall construct and maintain all necessary cutoffs, cofferdams, channels, dikes, berms, flumes, drains, sumps, pumps, erosion control measures and/or other temporary diversion and protection works necessary for diversion and care of all water during construction, and until project is completed.

The Contractor shall furnish, install, maintain, and operate all necessary pumps, equipment, and other facilities for dewatering and removal of water from the various parts of the project and for maintaining the foundations, excavations, and embankment free from water as necessary for constructing each part of the project in the dry.

The Contractor shall also follow the requirements of Section 107.19 - DAMAGE BY STORM, FLOOD OR EARTHQUAKE.

Drain or otherwise positively dewater borrow areas, embankment areas, structural excavations, trenches, and other areas as necessary to permit satisfactory

construction at all times. When an excavation extends below the water table, dewatering shall be accomplished in a manner that will maintain stability of the excavated slopes and bottom of the excavation, and will result in all construction operations being performed in the dry. The use of a sufficient number of properly screened sumps, wells, or other equivalent methods may be necessary for dewatering. Pumps shall be fitted with a meter to measure the amount of water pumped. The amount of water pumped from the excavation shall be reported to the Engineer on a monthly basis.

During the excavating, placing, and compacting of the embankment materials and concrete, trench excavation, placing pipe, trench backfill, or structural excavation, the water level at every point in the excavation shall be maintained below the bottom of the excavation.

After having served their purpose, all materials placed for temporary diversion, protection, handling, and removal of water shall remain the property of the Contractor and shall be removed from the site. Remove all cofferdams or other temporary diversion and protective works upstream and downstream from the embankment to prevent any obstruction to the flow of water.

## DAMAGE

The Contractor shall be responsible for, and shall repair at his expense, any damage to the embankments, foundations, structures, or any other part of the project caused by surface water, groundwater, or failure of any part of the diversion or protective works. In the event the construction area is flooded or otherwise damaged by water, Contractor shall clean up and repair the damage, dry out or remove material in foundations and embankments deemed too wet, weakened, or contaminated for proper foundation or fill material by the Engineer, all at the Contractor's expense. The Contractor shall be responsible for, and shall repair at his expense, any damage to areas downstream of the construction site caused by failure of any part of the diversion or protective work. The Contractor shall inspect, monitor, and repair cofferdam and other diversion works to maintain them in a safe condition. Erosion damage to any fills shall be repaired using materials and methods approved by the Engineer. Contractor shall repair all erosion damage to a condition that existed prior to erosion occurring.

The Contractor shall also follow the requirements of Section 107.19 - DAMAGE BY STORM, FLOOD OR EARTHQUAKE.

## PAYMENT

Payment shall be made on the basis of the lump sum price bid and shall be full compensation for supplying and furnishing all materials, facilities, and services and performing all work involved as specified herein.

### ITEM 107-4 - DIVERSION AND CARE OF WATER

Payment for dewatering shall be made on the basis of the unit price bid per million gallons pumped and shall be full compensation for supplying pumps, piping, hoses and all other materials, facilities and services required to dewater the excavations as specified herein.

### ITEM 107-5 - DEWATERING

## SECTION 108 - COMMENCEMENT, PROSECUTION AND PROGRESS

### 108.1 - NOTICE TO PROCEED

Delete Paragraph (A) and replace with the following:

- (A) Contractor shall commence work within seven (7) calendar days after the date of the Notice to Proceed and complete all work within two hundred ten (210) calendar days beginning the day following the effective date specified in the Notice to Proceed.

### 108.2 - SUBLETTING OF CONTRACT

Add the following:

For this project, Contractor shall perform, with its own organization, work amounting to 50 percent or more of the total contract cost.

## **108.4 - CONTRACTOR'S CONSTRUCTION SCHEDULE**

Delete in its entirety and replace with the following:

FCDMC and the Contractor will plan and coordinate the construction activities with the Town and School District to minimize the impact on town and School District activities.

The Contractor shall arrange and schedule all of his work activities in order to accomplish the following:

- Eliminate any delays or hazardous conditions to the public.
- Minimize the amount of interference among the various Subcontractors.
- Perform the work in an orderly manner.
- Complete the work within the specified project duration.

**In addition, the Auxiliary Outlet Works box culvert (not including inlet and outlet structures) shall be constructed in place and backfill placed to elevation 1705 or higher prior to July 1. This is required to provide sufficient capacity to drain the reservoir quickly during the Monsoon. Failure to complete the outlet works box culvert by the required date and to the satisfaction of the Engineer may result in assessment of liquidated damages as specified in Subsection 108.9.**

Contractor shall submit a proposed work progress schedule to the Engineer for review before starting work. Weekly updates shall be submitted to the District Inspector at the weekly coordination meeting.

### **108.4.1 - ESTIMATED BILLING SCHEDULE**

Add the following to the MAG Standard Specifications:

Contractor shall furnish the Engineer an Estimated Billing Schedule for the total project at the preconstruction conference, and thereafter at monthly intervals as agreed to between Contractor and Engineer.

### **108.5 - LIMITATIONS OF OPERATIONS**

Add the following to the MAG Standard Specifications:

The normal work week shall be 40 hours, Monday through Friday, and the work hours will be determined at the pre-construction meeting. This does not imply that this contract can be completed on time utilizing normal working hours. The Contractor shall furnish sufficient forces and shall work such hours including night shifts and overtime operations as necessary to ensure the completion of the work within the time required. To work other than normal working hours, for other than emergency situations, the Contractor shall give the Engineer at least 24 hours advance notification and receive written approval before working. Should the Contractor elect to perform any work after regular working hours, on weekends, or legal holidays, "with or without written approval of the Engineer", any charges incurred by the Owner for inspection of the work, surveys or tests of materials will be deducted from monies due or to become due to the Contractor.

The Contractor shall also be subject to the requirements in Fountain Hills Town Ordinance No. 96-26, Section 1 as reproduced below:

#### **ORDINANCE 96-26**

*AN ORDINANCE OF THE MAYOR AND COMMON COUNCIL OF THE TOWN OF FOUNTAIN HILLS, ARIZONA, AMENDING ITS TOWN CODE; CHAPTER 7 "BUILDINGS AND BUILDING REGULATIONS" BY ADDING A NEW ARTICLE 7-6 FOR NOISE REGULATIONS DURING CONSTRUCTION WORK.*

*BE IT ORDAINED BY THE MAYOR AND COMMON COUNCIL OF THE TOWN OF FOUNTAIN HILLS, ARIZONA AS FOLLOWS:*

*SECTION 1. That the Town Code, Chapter 7 Buildings and Building Regulation, be amended by the Addition of Article 7-6, "Noise Regulations During Construction" to read as follow:*

*A. During the times hereinafter set forth, no construction activities of any kind, including but not limited to the making of an excavation, clearing of surface land, and loading or unloading material, equipment or supplies, or the operation of mechanically powered tools anywhere in the Town limits, shall be permitted, when such activities result in the generation of mechanically or electrically created noise that can be heard by a person with normal hearing within a residential building, the windows of which are closed, if such building is located within 500 feet of the construction site.*

*B. The foregoing limitations shall apply to the following times:  
Prior to 5:30 a.m. and after 6:30 p.m. Monday through Friday from May 15 through September 15.*

- a. *Prior to 6:00 a.m. and after 6:30 p.m. Monday through Friday during the remainder of the year.*
  - b. *Prior to 7:00 a.m. and after 5:00 p.m. on Saturdays throughout the year.*
  - c. *At all times during Sunday and Legal Holidays.*
- C. *The following activities shall be excluded from such prohibition:*
- a. *Noise resulting from perishable activities, defined as all concrete flat work, termite pre-treatment application and the delivery of perishable landscaping materials shall be allowed as necessary.*
  - b. *Noise generated by work being performed by a resident of a building or structure may continue until 10:00 p.m. but may not begin earlier than the times set forth in Section B. above.*
  - c. *Noise resulting from emergencies, including but not limited to repair of roofs, windows, doors, electrical, plumbing and mechanical (HVAC) shall be permitted whenever necessary. An emergency shall be defined as any situation where work must be performed in order to prevent serious injury to persons or property.*

#### **Section 7-6-2: PENALTIES**

*Violation of any provision of Section 7-6-1 is a civil offence, The Municipal Court of the Town shall conduct a hearing and shall assess a sanction of \$100 for a first violation; \$200 for a second violation and \$500 for all subsequent violations. Each day a violation occurs shall constitute a separate event.*

#### **108.9 - FAILURE TO COMPLETE ON TIME**

Add the following to the MAG Standard Specifications:

The actual cost per calendar day incurred by Owner for Consultant Administrative and Inspection Services on this project will be added to the daily charges as indicated by TABLE 108-1 LIQUIDATED DAMAGES, and will be deducted from monies due or to become due to Contractor for each and every calendar day that work shall remain incomplete after the time specified for the completion of the work in the proposal, or adjusted by Engineer. Nothing contained in the provision shall prohibit Owner from deduction from monies due or to become due to Contractor for any other costs incurred by Owner directly attributable to the delay in completing this contract.

## **SECTION 109 - MEASUREMENTS AND PAYMENTS**

### **109.1 - MEASUREMENT OF QUANTITIES**

add the following to the MAG Standard Specifications:

Scales of acceptable size shall be furnished by the Contractor and shall be sealed by an inspector of the Department of Weights and Measures, State of Arizona, or a Licensed Service Agency approved by the State of Arizona Department of Weights and Measures. The Licensed Service Agency certifying the scales shall not be affiliated with the Contractor or company supplying the materials for payment by weight.

### **109.2 - SCOPE OF PAYMENT**

Add the following to the MAG Standard Specifications:

In addition to contained provision, the work under this section shall consist of preparatory work and operations, including but not limited to, the movement of personnel, equipment, supplies and incidentals to the project site; the establishment of all offices, buildings and the facilities necessary for work on the project, and for all other work operations that must be performed and costs incurred prior to beginning work on the various items on the project site.

### **109.7 - PAYMENT FOR BOND ISSUE AND BUDGET PROJECTS**

Add the following to the MAG Standard Specifications:

- (A) To third paragraph, add: Payment or release of retained funds shall be made to contractor within thirty (30) days following final payment to the contractor (reference (B) following), and contractor furnishing to Engineer satisfactory receipts for all labor and material billed and waiver of Liens from any and all persons and subcontractors holding claims against the work. Additionally, Contractor shall furnish a completed Certificate of Performance to Engineer evidencing it has satisfactorily discharged all item duties in connection with the work to be performed under this Contract. The form of Certificate of Performance shall be provided to Contractor by the Engineer.

- (B) Delete second and third paragraphs and replace with: The final payment will be made to Contractor by Owner within thirty (30) days following receipt of Engineer's final estimate and receipt by Owner of Consent of Contractor Surety to said final payment.

If payment will be longer than thirty (30) days as aforesaid, Owner will provide Contractor specific written findings for reasons justifying the delay in payment.

- (C) Contractor's pay estimate will be initially processed by Owner's Construction and Operations Division on a Tuesday, Tuesdays being the only day Contractor may submit a pay estimate. *Change this to match most recent contract language*

### 109.9 - FORCE ACCOUNT WORK

Add the following to the MAG Standard Specifications:

- (A) General

When force account work is shown in the bidding schedule or when work is to be performed in accordance with the requirements and provisions of Subsection 104.02 and such work is to be paid for as force account, the amount of such payments will be determined in accordance with the provisions of this Subsection.

- (1) Labor

For all labor, including foreman in direct charge of specific operations, but excluding general superintendence, the Contractor will be paid:

- (a) Regular pay (RP) which will be determined as follows:

$$RP = (WR + FR) \times 1.5$$

Where:

WR = hourly wage rate as determined by payroll

FR = fringe benefit rate as determined by payroll

The Contractor shall provide the hourly wage rates and fringe benefit rate at the preconstruction conference. The rates will be verified by comparison to the Contractor's payrolls.

- (b) Overtime pay (OT) which will be determined as follows:

$$OT = [(WR \times 1.5) + FR] \times 1.5$$

- (c) Subsistence and travel allowances paid to workers as required by collective bargaining agreements.

(2) Materials

For all materials accepted by the Engineer and used in the work, the Contractor will be paid the actual invoice cost of such materials including actual freight and express charges less all offered or available discounts and rebates, not withstanding the fact that they may not have been taken by the Contractor. To the above cost will be added a sum equal to 15 percent thereof.

The District reserves the right to furnish such materials as it deems appropriate, and the Contractor shall have no claims for any costs, overhead or profit on materials provided by the District.

No partial payment will be allowed. The Contractor shall be compensated for materials after the materials invoice is submitted along with any documentary backup for the cost of materials.

(3) Equipment

Equipment which the Engineer considers necessary for the performance of work will be eligible for payment at the established rates only during the hours that it is operated except as otherwise allowed elsewhere in these specifications. Equipment hours will be recorded to the nearest one-half hour. For the use of equipment owned by the Contractor and approved by the Engineer, the Contractor will be paid the rental rates, as modified herein, set forth in the Rental Rate Blue Book (RRBB) for Construction Equipment which is published by the Equipment Guide-Book Company, a division of Nielson - Dataquest, 1290 Ridder Park Drive, San Jose, California 95131, Phone (800) 669-3282. All rate determinations will be based on the Blue Book rental rate chapter revisions that are applicable at the time the equipment is being used.

(a) Rental Rates (Without Operators)

The hourly equipment rental rate (HERR) will be determined by the following formula:

$$HERR = F \times \left( \frac{R}{176} \right) + HOC$$

Where:

F = Adjustment factor equal to 0.933.

R = Current RRBB Monthly Rate

HOC = Hourly operating cost

The hourly operating cost represents the major costs of equipment operation, such as fuel and oil, lubrication, field repairs, tires, expendable parts and supplies.

For each piece of equipment used, whether bought or rented, the Contractor shall provide the Engineer with the following information: the manufacturer's name, equipment type, year of manufacture, model number, type of fuel used, horsepower rating, attachments required, together with their size or capacity and any further information necessary to ascertain the proper rate.

When multiple attachments are included with the rental equipment, only the attachment having the higher rental rate will be eligible for payment, provided the attachment has been approved by the Engineer as being necessary to the force account work.

Rental charges will not be allowed for tools or equipment that show a daily rate less than five dollars or for unlisted equipment that has a value of less than four hundred dollars.

The above provisions apply to approved equipment of modern design and in good working condition. The equipment shall be handled and used to provide normal output or production. Equipment that is not in good working condition or is not of proper size for efficient performance of the work may be rejected by the Engineer. Equipment ordered for force account work will be paid for until such time as the Engineer directs that the use of such equipment be discontinued or until completion of the work.

Unless otherwise specified, manufacturer's ratings and manufacturer-approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.

If it is deemed necessary by the Engineer to use equipment not listed in the above publication, a suitable rate for such equipment will be established by the Engineer. The Contractor may furnish cost data which might assist the Engineer in the establishment of such rental rate. The rental rates shall be agreed to in writing prior to the use of such equipment on force account work or paid for by invoices in the case of outside rented equipment.

(b) Stand-By Time

Equipment that is in operational condition and is standing by with the Engineer's approval for participation in Force Account Work shall be paid for according to the following Stand-By Rate (SBR):

$$SBR = F \times \left( \frac{R}{176} \right) \times 1/2$$

Payment for "stand-by" will be limited to not more than eight hours in a 24-hour day or 40 hours in a normal week. No compensation shall be allowed for equipment that is inoperable due to breakdown. No payment shall be allowed for equipment that is not operating because work has been suspended by the Contractor for the Contractor's reasons.

(c) Outside Rented Equipment

In cases where a piece of equipment to be used is rented or leased by the Contractor from a third party exclusively for force account work, the Contractor will be paid as follows:

Rental Invoice + HOC

(d) Owner-Operated Equipment

Payment for rental of equipment owned and operated by persons other than the prime Contractor's or SubContractor's will be based on the actual paid invoice.

An amount equal to 10 percent of the total rental of the equipment, including the owner-operator, will be added for overhead, profit and all other costs incidental to furnishing and operating the equipment. The Engineer shall approve the rental rates prior to commencement of the work.

(E) MOVING OF EQUIPMENT

Rental time will also be allowed for the time required to move needed equipment to the location of the force account work and to return it to its original location. Loading and transportation costs will be allowed in lieu of moving times when equipment is moved by means other than its own power. Moving time back to the original location or loading and transportation costs will not be allowed if the equipment is used at the site of the force account work on contract items or related work.

For use of equipment moved on the work exclusively for force account work, the cost of transferring the equipment to the site of the work and returning it to the

original location will be allowed as specified herein as an additional item of expense.

The original location of the equipment to be hauled to the site of the work shall be agreed to by the Engineer in advance.

Where the move of the equipment is made by common carrier, the allowance will be the invoiced amount paid for the freight plus fifteen percent. If the Contractor hauls the equipment with its own forces, rental will be allowed for the hauling unit plus the driver's wages and the cost of loading and unloading the equipment.

The maximum rental period for the day that the equipment is moved on the work and the day that the use of the equipment is discontinued shall be the actual time that the equipment is in operation on force account work.

(4) Superintendence

No part of the salary or expense of anyone connected with the Contractor's forces above the grade of foreman and having general supervision of the work will be included in the labor items as specified above, except when the Contractor's organization is entirely occupied with force account work, in which case the salaries of the superintendent and the timekeeper may be included in the labor item specified above when the nature of the work is such that their services are required.

(5) Compensation

The compensation as set forth above shall be received by the Contractor as payment in full for work done on a force account basis. In addition, the Contractor shall be paid an amount equal to 65 percent of the force account compensation times the applicable sales tax rate.

(6) Statements

All statements shall be accompanied and supported by receipted invoices for all materials used and transportation charges. If materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then instead of invoices, the statements shall contain or be accompanied by an affidavit of the Contractor certifying that such materials were taken from stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

The Contractor and Subcontractor shall submit an equipment list for all equipment to be used during the contract, an equipment rate sheet, and a labor rate sheet, all within 30 days after contract award, but prior to the start of any force account work.

The Contractor shall submit payrolls and other cost data documents for all force account work within 30 calendar days after completion of the work. No partial payment will be made. All invoiced work must have documentation for payment. Final payment will not be made for work performed on a force account basis until the Contractor has furnished duplicate itemized statements of the cost of such force account work detailed to the following:

Name, classification, date, daily hours, total hours, rate and amount for each foreman and laborer.

Designation, dates, daily hours, total hours, rental rate and amount for each unit of equipment.

Quantities of materials, prices and amounts.

Transportation charges on materials, FOB jobsite.

(B) Force Account Work by SubContractors

When force account work is determined by the Engineer to require specialized labor or equipment not normally utilized by the Contractor, and such force account work is performed by Subcontractors, the Contractor will be allowed an additional markup based on the following:

- (1) For the first \$10,000.00 of work performed by Subcontractors (less markups for overhead and profit), the Contractor will be allowed a 10-percent supplemental markup.
- (2) For all work in excess of \$10,000.00 performed by Subcontractors (less markups for overhead and profit), the Contractor will be allowed a five percent supplemental markup.

The 10-percent supplemental markup shall apply to the first accumulated total of all force account work performed by Subcontractors.

(C) Bond

An amount of 0.5 percent of the total amount will be added for the Performance and Payment Bond.

(D) NON-ALLOWABLE CHARGES

If the Contractor chooses to accept Force Account, then the Contractor's compensation in any Supplemental Agreement will only be for what is stated in the above Force Account provisions.

Whether the amount of Supplemental Agreement negotiated is for unit price, Lump Sum Agreement or Force Account, in no case will the Contractor be reimbursed for the following items:

- (1) Profit in excess of that provided herein;
- (2) Loss of profit;
- (3) Home office overhead;
- (4) Consequential damages, including loss of bonding capacity, loss of bidding opportunities and insolvency;
- (5) Indirect costs or expenses of any nature;
- (6) Attorneys fees, claims preparation expenses or costs of litigation;  
or
- (7) Interest

## **SECTION 110 - SUBMITTAL PROCEDURES**

### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-01330 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

### **SUBMITTAL IDENTIFICATION**

Submittals required are identified by SD numbers as follows:

#### **SD-01 DATA**

Submittals which provide calculations, descriptions, or documentation regarding the work.

#### **SD-04 DRAWINGS**

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

#### SD-06 INSTRUCTIONS

Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

#### SD-07 SCHEDULES

Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

#### SD-08 STATEMENTS

A document, required of the Contractor, or through the Contractor, from a supplier, installer, manufacturer, or other lower tier Contractor, the purpose of which is to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verifications of quality.

#### SD-09 REPORTS

Reports of inspections or tests, including analysis and interpretation of test results.

#### SD-13 CERTIFICATES

Statement signed by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the product, system or material meets specified requirements. The statement must be dated after the award of the contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements which are being certified.

## SD-14 SAMPLES

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

## SD-18 RECORDS

Documentation to record compliance with technical or administrative requirements.

## SD-19 OPERATION AND MAINTENANCE MANUALS

Data which forms a part of an operation and maintenance manual.

## **SUBMITTAL CLASSIFICATION**

Submittals are classified as follows:

### DISTRICT APPROVED (DA)

District approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Engineer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

### INFORMATION ONLY (FIO)

All submittals not requiring District approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

## **APPROVED SUBMITTALS**

The Engineer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Engineer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

### **DISAPPROVED SUBMITTALS**

The Contractor shall make all corrections required by the Engineer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice of such "change" shall be given promptly to the Engineer.

### **WITHHOLDING OF PAYMENT**

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

### **EXECUTION**

### **GENERAL**

The Contractor shall make submittals as required by the specifications. The Engineer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring District approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon

completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

## **SCHEDULING**

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time shall be allowed for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals..

## **SUBMITTAL PROCEDURE**

Submittals shall be made as follows:

### **PROCEDURES**

The Contractor shall submit to the Engineer, six (6) copies of all submittals requiring District approval and four (4) copies of submittals which are For Information Only.

### **DEVIATIONS**

The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The District reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

## **CONTROL OF SUBMITTALS**

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date.

## **DISTRICT APPROVED SUBMITTALS**

Upon completion of review of submittals requiring District approval, the submittals will be identified as having received approval by being so stamped and dated. Four copies of the submittal will be retained by the Engineer and two copies of the submittal will be returned to the Contractor.

## **INFORMATION ONLY SUBMITTALS**

Normally submittals for information only will not be returned. Approval of the Engineer is not required on information only submittals. The District reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Engineer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the District laboratory or for check testing by the District in those instances where the technical specifications so prescribe.

**STAMPS**

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

<b>CONTRACTOR</b> (Firm Name)	
_____	Approved
_____	Approved with corrections as noted on submittal data and/or attached sheets(s).
Signature:	_____
Title:	_____
Date:	_____

## SECTION 111 - CONTRACTOR QUALITY CONTROL

### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-01451 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740 (1996) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (1995b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

### PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

### EXECUTION

#### GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with these specifications. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract

requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Engineer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

## **QUALITY CONTROL PLAN**

The Contractor shall furnish for review by the District, not later than 14 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract. The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The District will consider an interim plan for the first 21 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

## **CONTENT OF THE CQC PLAN**

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.
- b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.
- c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives

outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the District.

- d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 110 SUBMITTAL PROCEDURES.
- e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Engineer.)
- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.
- g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.
- h. Reporting procedures, including proposed reporting formats.
- i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

#### ACCEPTANCE OF PLAN

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The District reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

## **NOTIFICATION OF CHANGES**

After acceptance of the CQC Plan, the Contractor shall notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

## **COORDINATION MEETING**

After the Preconstruction Conference, before start of construction, and prior to acceptance by the District of the CQC Plan, the Contractor shall meet with the Engineer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 3 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the District's Quality Assurance. Minutes of the meeting shall be prepared by the District and signed by both the Contractor and the Engineer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

## **QUALITY CONTROL ORGANIZATION**

### **PERSONNEL REQUIREMENTS**

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure contract compliance. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Engineer.

### **CQC SYSTEM MANAGER**

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC

System Manager shall be a construction person with a minimum of 10 years in related work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned as System Manager but may have duties as project superintendent in addition to quality control. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

## CQC PERSONNEL

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: materials technician. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan.

Experience requirement:

Concrete, Pavements and Soils

Materials Technician with  
2 yrs experience for the  
appropriate area

## ORGANIZATIONAL CHANGES

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Engineer for acceptance.

## SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 110 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

## CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

### PREPARATORY PHASE

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

- a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by District personnel until final acceptance of the work.
- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
- g. A review of the appropriate activity hazard analysis to assure safety requirements are met.
- h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
- i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Engineer.

- j. Discussion of the initial control phase.
- k. The District shall be notified at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

#### INITIAL PHASE

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

- a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
- b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.
- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- f. The District shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
- g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

## FOLLOW-UP PHASE

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

## ADDITIONAL PREPARATORY AND INITIAL PHASES

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

## TESTS

### TESTING PROCEDURE

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the District duplicate samples of test specimens for possible testing by the District. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of an approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.
- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

- e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Engineer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Engineer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

## TESTING LABORATORIES

### CAPABILITY CHECK

The District reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

### ONSITE LABORATORY

The District reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the District.

### FURNISHING OR TRANSPORTATION OF SAMPLES FOR TESTING

Costs incidental to the transportation of samples or materials shall be borne by the Contractor.

### COMPLETION INSPECTION

## PUNCH-OUT INSPECTION

Near the end of the work, or any increment of the work as established by the specifications or by the Engineer, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the District that the facility is ready for the District Pre-Final inspection.

## PRE-FINAL INSPECTION

The District will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A District Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the District, so that a Final inspection can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

## FINAL ACCEPTANCE INSPECTION

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Engineer's Representative shall be in attendance at the final acceptance inspection. Additional District personnel including, but not limited to, those from ADWR may also be in attendance. The final acceptance inspection will be formally scheduled by the Engineer based upon results of the Pre-Final inspection. Notice shall be given to the Engineer at least 7 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Engineer to bill the Contractor for the District's additional inspection cost.

## DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.
- g. Offsite surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the District daily within 48 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System

Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

## **NOTIFICATION OF NONCOMPLIANCE**

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

## **SECTION 112 - TEMPORARY CONSTRUCTION FACILITIES**

### **GENERAL REQUIREMENTS**

The work under this section shall consist of preparatory work and operations, including but not limited to mobilization; the movement of personnel, equipment, supplies and incidentals to the project site; the establishment of all offices, buildings and other facilities necessary for work on the project, and for all other work and operations that must be performed and costs incurred prior to beginning work on various items on the project site.

### **SITE PLAN**

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired. The site plan shall be submitted to the Engineer for review prior to beginning the work.

## IDENTIFICATION OF EMPLOYEES

The Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display, identification as approved and directed by the Engineer. Prescribed identification shall immediately be delivered to the Engineer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

## EMPLOYEE PARKING

Contractor employees shall park privately owned vehicles in an area designated by the Engineer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the city of school district.

The paved parking lot at the park (shown on the project plans) is designated for equipment parking and material storage. Protect pavement from damage due to overloading, penetration, scarring, discoloration, or fuel and oil spills.

Store materials in an orderly manner. Fuel and oil stored in drums or tanks on site are to be protected against spills by containment equipment or impervious berms of sufficient volume to wholly contain the amount in storage.

## AVAILABILITY AND USE OF UTILITY SERVICES

### PAYMENT FOR UTILITY SERVICES

Unless otherwise specified in the contract, the Contractor shall arrange for all connections to required utilities and shall pay for all charges for connection and service.

### SANITATION

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Engineer. District toilet facilities will not be available to Contractor's personnel.

## TELEPHONE

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

## **BULLETIN BOARD AND PROJECT SIGNS**

### BULLETIN BOARD

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Engineer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Engineer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

### **PROTECTION AND MAINTENANCE OF TRAFFIC**

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Engineer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations. The traffic control plan shall be submitted to the Engineer and the Town for review prior to beginning construction.

## HAUL ROADS

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads within the project site shall be subject to approval by the Engineer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the Engineer shall be removed and the area restored to its previous condition.

## BARRICADES

All construction limits and zones at the project site are to be within the public closure areas. Construction limits are to be defined by flagging and approved by the Town and School District before work begins. All activities of construction equipment and personnel will be within the confines of these limits unless otherwise approved by the Town or School District.

Safety of workers and the public is of utmost importance and is to be stressed as a priority to construction personnel at every opportunity. For added safety, barricades will be used in specific construction zones during the project, such as around open trenches or operating equipment. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

Areas at the project site which pose a potential hazard to the public during construction are to be closed to public entry. Signs, barricades and temporary fences required to inform the public and prevent public entry are to be provided and maintained as part of the construction work. The contractor has responsibilities to help enforce the closure by maintaining barricades and informing people if they have violated the closure. The Town and School District will issue a Closure Order that informs the public of closure areas and provides authorization to cite trespassers. Town law enforcement personnel will be available to help with enforcement upon request.

## **CONTRACTOR'S TEMPORARY FACILITIES**

### **ADMINISTRATIVE FIELD OFFICES**

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site.

### **STORAGE AREA**

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored green or brown, so that visibility through the fence is obstructed. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Engineer away from the vicinity of the construction site. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

### **SUPPLEMENTAL STORAGE AREA**

Upon Contractor's request, the Engineer may designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the park or high school boundaries. Fencing of materials or equipment will be required at this site; and, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area.

### **APPEARANCE OF TRAILERS**

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Engineer, require exterior painting or maintenance will not be allowed.

### **MAINTENANCE OF STORAGE AREA**

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass located within the boundaries of the construction site shall be mowed for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

## SECURITY PROVISIONS

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

## DISTRICT FIELD OFFICE

This work shall consist of providing and maintaining a furnished field office for the exclusive use of and occupancy by the Engineer and the Engineer's staff.

The office shall be a building or mobile trailer erected at a location convenient to the project. The Contractor's and the Engineer's offices shall not be in the same building or mobile trailer although the offices shall be located next to each other or within reasonable walking distance.

The Contractor may furnish equivalent facilities in an existing building provided such facilities and building are located to provide convenient service.

The field office shall be an approved and weatherproof building or mobile trailer providing a minimum of 500 square feet of clear floor space, not including the toilet area. The structure shall have a minimum ceiling height of seven (7) feet and shall be provided with weatherproof doors equipped with adequate locking devices. Windows shall also be provided with adequate locking devices. The Contractor shall also provide the following:

- a. Lighting - Electric light, non-glare type luminaires to provide a minimum illumination level at desk height level.
- b. Heating & Cooling - Adequate electrically powered equipment to maintain an ambient air temperature of 72 degrees F plus or minus 8 degrees.

- c. Telephone, answering machine, plain paper FAX machine and copying machine. Two (2) telephones with two (2) outside lines for the exclusive use of the Engineer. The Contractor will pay for the cost of the line and local calling charges. The District will pay for long distance charges made on these lines.
- d. Toilet - A commode and wash sink in a separately enclosed room within the building or mobile trailer, properly ventilated and complying with applicable sanitary codes. Contractor shall provide water and sewer service.
- e. Maintenance - The Contractor shall maintain all facilities and furnished equipment in good working condition, and the office shall be cleaned weekly.
- f. Fire Extinguisher - Two non-toxic, dry chemical, fire extinguishers meeting Underwriters Laboratories, Inc. approval for Class A, B and C fires with a minimum rating of 2A:20B:10C.
- g. Electricity - Contractor shall provide electric power and pay for all electric services.
- h. Furnishings - Three office desks with drawers, five office chairs (padded, swivel type), one drafting table (adjustable height) 1 meter by 2 meter, one eight foot (8') conference table, twelve folding chairs, one four drawer legal size file cabinet, and one draftsman's stool. All furnishings shall be in good working order.
- i. First Aid Kit
- j. Potable water supply or service.

The office shall be fully equipped and made available for the Engineer's use and occupancy prior to the start of any Contract work and not later than 10 days after the date of the Notice to Proceed. The Engineer will notify the Contractor, in writing, of the acceptability of the Field Office provided. The Contractor shall maintain the field office in operation condition until seven (7) days after acceptance of the Contract work. All facilities shall be maintained in good operating condition and appearance by the Contractor for the designated period, after which all portable buildings or trailers, fencing, surfacing, and utilities shall be removed from the site, the areas cleaned and seeded if required and left in a neat and acceptable condition.

#### **TEMPORARY PROJECT SAFETY FENCING**

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and erect temporary project

safety fencing at the work site. Location and extents of the fencing shall be approved by the Engineer. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

## **CLEANUP**

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

## **RESTORATION OF STORAGE AREA**

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

## **PAYMENT**

Payment shall be made on the basis of the lump sum price bid and shall be full compensation for supplying and furnishing all materials, facilities, and services and performing all work involved as specified herein. The lump sum price bid shall not exceed three (3%) percent of the total project bid amount exclusive of mobilization, permits and licenses. No additional payment will be made for occupancy and services during periods of contract extension of time due to engineering changes or shutdowns.

The adjustment provisions in the MAG Uniform Standard Specifications Section 109 shall not apply to the item of Mobilization. When other contract items are adjusted as provided in Section 109, and if the costs applicable to such items of work include mobilization cost, such mobilization costs will be considered and recovered by the Contractor in the lump sum price paid for mobilization, and will be excluded from

consideration in determining compensation under Section 109.

**ITEM 112-1 - MOBILIZATION**

**GOLDEN EAGLE PARK DAM IMPROVEMENTS**

**SPECIAL PROVISIONS**

\*\*\* **NOT APPROVED FOR CONSTRUCTION** \*\*\*

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# FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

## GOLDEN EAGLE PARK DAM IMPROVEMENTS FOUNTAIN HILLS, ARIZONA

CONTRACT 1999C071  
PCN 6700331

### Special Provisions

#### SECTION 201 - CLEARING AND GRUBBING

##### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02230 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Areas to be cleared and grubbed include but are not limited to: the fence lines, top of dam, face of dam, principal, auxiliary and emergency spillways, auxiliary spillway chute and energy dissipater and channel to Ashbrook Wash, emergency spillway, berm and floodwall areas.

##### DEFINITIONS

##### CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

## GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

## EXECUTION

### CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. Clearing shall also include the removal and disposal of structures and rocks that obtrude, encroach upon, or otherwise obstruct the work.

## GRUBBING

### AREAS OUTSIDE THE DAM FOOTPRINT

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for structures, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

## DAM EMBANKMENT

Clearing and grubbing on the downstream dam embankment shall extend no more than 6 inches below the original surface level of the ground. Clearing on the downstream embankment shall consist of removing large, deep rooted species of plants and trees as defined by ADWR. Holes remaining after removal of trees and bushes shall be backfilled with approved native material. Rill erosion 6 inches or deeper shall be filled with approved pervious material. Material and backfill requirements shall be per Section 203 - EARTHWORK and Section 205 - EMBANKMENT FOR EARTH DAMS and shall be approved by Arizona Department of Water Resources (ADWR) and the Engineer.

The upstream side of the dam embankment shall be cleared and grubbed as defined herein and additional structural excavation and stripping to the required embankment or structure foundation elevations or to the rock abutment shall be conducted as specified in Section 203 - EARTHWORK and Section 205 - EMBANKMENT FOR EARTH DAMS and shall be approved by Arizona Department of Water Resources (ADWR) and the Engineer.

### **TREE REMOVAL**

Where indicated or directed, trees and stumps that are designated as trees shall be removed. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

### **DISPOSAL OF MATERIALS**

### **SALABLE TIMBER**

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths, and stockpiled at locations as directed. The disposal of the stockpiled timber will be by the Contractor.

### **MATERIALS OTHER THAN SALABLE TIMBER**

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of District-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be

placed. Burning of trash, debris, plant material, wood, or any other waste materials will not be allowed.

## MEASUREMENT AND PAYMENT

Clearing and grubbing will not be measured. Payment will be made at the contract lump sum price for clearing and grubbing, and this price shall constitute full compensation for all materials, labor, equipment, tools, and incidentals necessary to complete the work specified herein.

## ITEM 201-1 - CLEAR AND GRUB

## SECTION 203 - EARTHWORK

### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CECS-02300 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

All excavation including the areas on the dam, abutments, spillway, channel and retaining walls shall be conducted per this section unless otherwise specified. Embankment fill and backfill for the dam and spillway shall be per Section 205 EMBANKMENT FOR EARTH DAMS.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136 (1996) Sieve Analysis of Fine and Coarse Aggregates

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D 1140	(1992) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

## DEFINITIONS

### SATISFACTORY MATERIALS

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, CL-ML. Satisfactory materials for grading shall be comprised of stones less than 6 inches, except for fill material for pavements which shall be comprised of stones less than 3 inches in any dimension.

### UNSATISFACTORY MATERIALS

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Engineer shall be notified of any contaminated materials.

## COHESIONLESS AND COHESIVE MATERIALS

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, and CL. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

## DEGREE OF COMPACTION

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698 abbreviated as a percent of laboratory maximum density.

## TOPSOIL

Topsoil shall conform to Section 425 – TOPSOIL.

## SUBMITTALS

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110:

SD-08 Statements

Earthwork; FIO

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material.

SD-09 Reports

Testing; DA

Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests.

#### SD-13 Certificates

Testing; DA

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

#### SD-18 Records

Earthwork; FIO

Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas.

### **SUBSURFACE DATA**

Subsurface soil boring logs are shown on the drawings. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at the DISTRICT office. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

### **CLASSIFICATION OF EXCAVATION**

Excavation specified shall be done on a classified basis, in accordance with the following designations and classifications.

### **ROCK EXCAVATION**

Rock is defined as material which cannot reasonably be ripped with a single shank ripper on a Caterpillar D-9 or equal for grading work or material which cannot reasonably be excavated with a Caterpillar 235 excavator or equal, equipped with an approved 2 cubic yard V bottom rock bucket with a minimum of 2 ripper shanks for trenching work. Determination of "reasonable" or "equal" rests solely with the Owner's Representative.

Rock excavation shall include excavating, grading, and disposing or re-use of material classified as rock and shall include the satisfactory removal and disposal of boulders 1/2 cubic yard or more in volume; solid rock; rock material that is in ledges, bedded deposits, unstratified masses and firmly cemented conglomerate deposits (Caliche) which meet the above definition. If at any time during excavation, the Contractor encounters material that may be classified as rock excavation, such material shall be uncovered and the Engineer notified by the Contractor. The Contractor shall not proceed with the excavation of this material until the Engineer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Engineer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Engineer for the areas of work in which such deposits occur.

Note: this section is applicable only if the rock foundation under the dam, principal or auxiliary outlet works or emergency spillway is exposed. It is anticipated that rock or cemented soils (Caliche) could be exposed during excavation for the footings on the principal outlet works apron and wingwalls, and for construction of the sand diaphragm trench on the auxiliary outlet works.

#### COMMON EXCAVATION

Common excavation shall include the satisfactory removal and disposal or re-use of all materials not classified as rock excavation.

#### BLASTING

Blasting will not be allowed.

#### UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be the property of the Contractor and removed from the site. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall become the property of the contractor and shall be removed from the site. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments

adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

## **EXECUTION**

### **STRIPPING OF TOPSOIL**

Where indicated or directed, topsoil shall be stripped as specified on the plans or as directed by the Engineer. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

### **GENERAL EXCAVATION**

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from other approved areas selected by the Contractor as specified.

### **DITCHES, GUTTERS, AND CHANNEL CHANGES**

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches

and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Excess excavation in the emergency spillway channel shall be backfilled or repaired as specified in Section 205 - EMBANKMENT FOR EARTH DAMS. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

### **Construction Requirements:**

All emergency spillway excavation shall be finished to a reasonably smooth, uniform surface; shall not vary by more than 0.1 foot from the lines and grade established; and shall be in reasonably close conformance to the lines, dimensions and cross-sections shown on the plans or established by the Engineer. The average cross sectional area shall not be less than that shown on the plans. Any variation in excess of this shall be corrected by trimming back the high spots.

All waterways shall be constructed to drain effectively.

Suitable materials from the spillway excavation shall be used in the construction of dam embankment or berms and other uses as shown on the project plans, specified in the special provisions or as directed by the Engineer. Unsuitable and surplus excavation material shall be disposed of as directed by the Engineer.

Blockage of the emergency spillway due to equipment, material stockpiles or other reasons will not be allowed to remain for more than 24 hours.

A minimum width of 100 feet at the emergency spillway crest must be kept clear at all times.

Foundation preparation, cleanup and repair by dental grouting with mortar or concrete may be required and will be performed according to Section 204 – FOUNDATION PREPARATION or Section 205 EMBANKMENT FOR EARTH DAMS.

### **DRAINAGE STRUCTURES**

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall

not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

## **SELECTION OF BORROW MATERIAL**

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown or from other approved sources, either private or within the limits of the project site, selected by the Contractor. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on District-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

## **OPENING AND DRAINAGE OF EXCAVATION**

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

## **PREPARATION OF GROUND SURFACE FOR EMBANKMENTS**

### **SUBGRADE PREPARATION**

#### Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown or 6 inches minimum. When more than one soil classification is present in the

subgrade, the top 6 inches of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

## **FINISHING**

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

## **PLACING TOPSOIL**

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 6 inches or to the depth shown on the plans and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from approved commercial sources.

## **TESTING**

Quality assurance and acceptance testing of compacted embankments will be conducted by the Owners Representative. Testing shall be performed by an approved commercial testing laboratory.

Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Engineer. ASTM D 2937, Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Engineer, that compaction is not as specified, the material

shall be removed, replaced and recompactd to meet specification requirements. Tests on recompactd areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the Engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

#### FILL AND BACKFILL MATERIAL GRADATION

Minimum of one test per 1,000 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422, or ASTM D 1140 as appropriate.

#### IN-PLACE DENSITIES

- a. Minimum of one test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
- b. Minimum of one test per 100 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.
- c. Minimum of one test per 1,000 linear feet, or fraction thereof, of each lift of embankment or backfill for roads.

#### CHECK TESTS ON IN-PLACE DENSITIES

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

- a. Minimum of one check test per lift for each 10,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
- b. Minimum of one check test per lift for each 1,000 square feet, of fill or backfill areas compacted by hand-operated machines.
- c. Minimum of one check test per lift for each 10,000 linear feet, or fraction thereof, of embankment or backfill for roads.

## MOISTURE CONTENTS

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Engineer.

## OPTIMUM MOISTURE AND LABORATORY MAXIMUM DENSITY

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. Minimum of one representative test per 10,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

## SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until fill, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No fill, subbase, base course, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall fill, subbase, base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade.

## MEASUREMENT AND PAYMENT

The unit of measurement for excavation will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation operations. The volume to be paid for will be the number of cubic yards of material measured in its original position and removed from the excavation areas, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock, authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or

the volume of any material used for purposes other than directed. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

Excavation to be measured for payment shall include the following:

- stripping of the dam embankment to subgrade
- trench excavation through the dam to construct the box culvert
- excavation to construct the sand diaphragm
- excavation to construct the headwalls, wingwalls, energy dissipater and spillway floodwall
- excavation to widen and deepen the emergency spillway
- channel excavation in the wash up and downstream of the dam
- excavation to subgrade to place gabion and riprap erosion protection.

No separate payment will be made for other miscellaneous excavation not specifically included in the items listed above or in other bid items elsewhere in the specifications and the cost of this excavation shall be included in the cost of the appurtenant work.

Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

Excavation will be paid for at the contract unit prices per cubic yard for common or rock excavation.

#### **ITEM 203-1 - EXCAVATION, COMMON**

#### **ITEM 203-2 - EXCAVATION, ROCK**

### **EARTHWORK ADJUSTMENTS**

Neither variations in shrink or swell of material from those shown on plans, nor variations of shrink or swell from Contractor obtained sources shall be reason for establishing a quantity adjustment.

Adjustments in earthwork quantities due to revisions ordered by the Engineer will be isolated by measurement or calculations. The bidding schedule quantities will be adjusted by the amount of the ordered change and will not be included in any other adjustment of the bidding schedule quantities as specified in this subsection.

## SECTION 204 - FOUNDATION PREPARATION

### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02217 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Work specified within this section is limited to the dam embankment, abutment, and spillway areas. For foundation preparation work outside of the limits of the dam and spillway, use the applicable portions of Section 203 – EARTHWORK.

Note: this section is applicable only if the rock foundation under the dam, principal or auxiliary outlet works or emergency spillway is exposed. It is possible that rock or cemented soils (Caliche) may be exposed during excavation for the footings on the principal outlet works apron and wingwalls, or for construction of the sand diaphragm trench on the auxiliary outlet works.

### DEFINITIONS

#### Foundations

The rock foundation is comprised of the rock surfaces upon which embankment or concrete structures are placed. Vertical surfaces, where permitted or required by these specifications, are included.

#### Rock Joints

Rock joints are all planar and/or curvilinear fractures, including cracks, crevices, and seams which separate a rock mass into individual rock blocks of various sizes. They may be open or closed and may be filled with material other than rock material.

### MATERIALS

### Dental Concrete

Dental concrete shall conform to the requirements of ASTM C 387, normal weight and strength.

### Dental Mortar

Dental mortar shall conform with ASTM C 270 or ASTM C 387, Type N.

### Filter Material

Sand and gravel for filter materials shall meet the applicable requirements of Section 205 EMBANKMENT FOR EARTH DAMS.

## **EXECUTION**

## **EXAMINATION**

The limits of the proposed foundations for the various parts of the work are approximately as indicated on the drawings. The Engineer reserves the right to change the depth to, or the width of, the foundations if, conditions exposed in the foundation excavations, or as determined by exploratory drilling, warrant such modifications.

## **PREPARATION**

### Tools

Hand tools, where required or permitted by these specifications include, but are not limited to shovels, bars, picks, wedges, and brooms. Light power tools may be used in lieu of hand tools only when such use is approved.

### Air Jet

An air jet shall consist of a nozzle with a supply hose connected to a suitable source of compressed air. The compressed air shall have a pressure between 90 and 110 psi. The compressed air shall be controllable at the nozzle.

### Air/Water Jet

An air/water jet shall consist of a nozzle with associated controls and supply hoses connected to suitable sources of compressed air and water. Compressed air shall have a pressure between 90 and 110 psi. Water shall be introduced into the airstream at the nozzle when needed, at a rate of up to 30 gpm. The air and water shall be separately controllable at the nozzle.

### Water Jet

A water jet shall consist of a nozzle with a supply hose connected to a suitable source of water. The system shall be capable of delivering up to 200 gpm. The flow rate shall be controllable at the nozzle.

## **PRELIMINARY CLEANUP**

When the excavation has reached the approximate limits shown or when the Engineer determines that a satisfactory foundation may have been reached, the Engineer may direct that a preliminary cleanup be performed on all or any part of the rock foundation surface. This cleanup shall consist of removing all debris, loose rock, sand, silt, and other objectionable material by hand tools followed by air, water, air/water jets or any combination of additional methods approved or directed. The Engineer may require that the excavation be continued and the preliminary cleanup procedure repeated until a satisfactory foundation surface is reached.

## **FINAL CLEANUP AND FOUNDATION PREPARATION**

Unless otherwise directed, Final Cleanup and Foundation Preparation shall be performed. This work shall consist of removing loose and/or weathered rock and pockets of fines, sand, rock rubble or gravel and other objectionable material from the in place rock surface including areas of depression, large crevices, and open rock joints. The loose material need not be removed where the width of the

opening is less than 1/2 inches. Picking, barring, and hand excavation may be necessary to obtain a foundation surface free from loose, drummy, or shattered materials. Irregularities in the rock surfaces shall be trimmed to form a reasonable uniform slope on the abutments. Overhangs shall not be permitted at any location. The final rock surface shall be thoroughly cleaned by use of air jets, water jets or air/water jets or other approved method and shall be maintained in a clean condition until the placement of embankment or concrete thereon.

**DENTAL TREATMENT**

Dental treatment shall consist of excavation, if necessary, of the material in joints, cavities, depressions, and overhangs and the placement of concrete or mortar such that the final surface is satisfactory for the subsequent placement of embankment or concrete. Unless otherwise directed, Dental Treatment shall be performed in accordance with the following schedule:

Foundation Area	Minimum Width Joint to be treated
Exposed abutment rock beneath excavated portions of the dam embankment	1 inch
Foundation below concrete structures	1 inch

Joints and cavities shall be excavated to a depth 3 times the width (measured at the base of the excavation) of the joint or cavity.

**Dental Concrete**

Concrete shall be used to fill joints, cavities, depressions, and overhangs except where the use of mortar is required or permitted. Prior to placement, the surfaces of the joint, cavity, depression, or overhang will be thoroughly cleaned using air or water jets. The maximum aggregate size shall be as directed by the Engineer. The concrete shall conform with paragraph MATERIALS.

**Dental Mortar**

Mortar shall be used to fill joints, cavities, depressions, and overhangs when the width of the opening is less than 2 inches and at other areas as directed or approved. Placement of the sand-cement mortar will be accomplished by troweling or brooming the mortar into the cleaned joints, cracks, and crevices so as to provide a thorough seal. The surface moisture of the rock shall be such that

absorption of water from the mortar mix will be minimized. However, no standing water will be allowed. All mortar which cannot be worked into the joints, shall be removed from the rock surface. The mortar shall conform with paragraph MATERIALS.

#### Wetting

The area shall be kept wet by continuous spraying or by other approved method.

#### Protective Backfill

The final 2 feet of excavation, final cleanup and foundation preparation, inspection, dental treatment, and placement of the first 12 inches of backfill shall all be accomplished within a period of 24 hours. Within 48 hours after the start of the final excavation, the backfill shall have a minimum thickness of 3 feet.

#### Protective Concrete

The final 2 feet of excavation, cleanup, inspection, preparation, dental treatment, and placement of at least 6 inches of protective concrete, shall all be accomplished within a period of 48 hours.

### TESTS

#### General

The Contractor shall establish and maintain quality control for foundation preparation operations to assure compliance with contract specifications and shall maintain records of his quality control for all operations including but not limited to the following:

1. Quantity and type of equipment.
2. Strict adherence to foundation excavation limits and depths.
3. Orderly prosecution of inspections, mapping, and cleanup of foundation excavation areas.

4. Protective treatment and Dental treatment.

## **FOUNDATION INSPECTION AND GEOLOGIC MAPPING**

Inspections to determine adequacy of the foundations will be performed by the Engineer in all foundation areas between completion of excavation and placement of embankment or concrete. Foundations shall also be inspected and approved by ADWR prior to placing any concrete or embankment on the foundation. The Contractor will cooperate to the extent necessary to assist in inspection and mapping activities which may require additional survey control points and access. The Contractor will coordinate his schedule for foundation excavation and preliminary cleanup with the Engineer to insure that the cleanup, inspection, and mapping proceed in an orderly manner.

## **MEASUREMENT AND PAYMENT**

Payment will be made for costs for each preliminary cleanup satisfactorily performed at the direction of the Engineer. Payment will be made for each cleanup of the same area if more than one cleanup has been directed and satisfactorily performed.

Preliminary cleanup will be measured for payment by determining the area cleaned in square yards to the nearest square yard.

### **ITEM 204-1 - PRELIMINARY CLEANUP**

Payment will be made for costs associated with final cleanup of the area for each type of foundation preparation that has been satisfactorily prepared. Where preliminary cleanup has been directed and performed and the contractor subsequently performs final cleanup, payment will be made for preliminary cleanup. Payment will not be made for any cleanup subsequent to final cleanup.

Final cleanup will be measured for payment by determining the area cleaned in square yards to the nearest square yard.

### **ITEM 204-2 - FINAL CLEANUP**

Payment will be made for costs associated with foundation preparation of the area for each type of foundation preparation that has been satisfactorily prepared. Where preliminary cleanup has been directed and performed and the contractor subsequently performs foundation preparation, payment will be made for foundation

preparation. Payment will not be made for more than one foundation preparation of the same area.

Foundation preparation will be measured for payment by determining the area prepared in square yards to the nearest square yard.

#### **ITEM 204-3 - FOUNDATION PREPARATION**

Payment will be made for costs associated with dental concrete placed.

Dental concrete will be measured for payment by determining the volume in cubic yards to the nearest one-tenth cubic yard.

#### **ITEM 204-4 - DENTAL CONCRETE**

Payment will be made for costs associated with dental mortar placed.

Dental mortar will be measured for payment by determining the volume in cubic yards to the nearest one-tenth cubic yard.

#### **ITEM 204-5 - DENTAL MORTAR**

### **SECTION 205 - EMBANKMENT FOR EARTH DAMS**

#### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02330 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Embankment fill, backfill and foundation preparation specified within this section is limited to the dam embankment, abutment and spillway areas or as referenced in these specifications. For earthwork outside of the limits of the dam, the requirements in Section 203 – EARTHWORK shall apply.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- |         |  |
|---------|--|
| M57-80  | Materials for Embankments and Subgrades                        |
| M146-91 | Terms Relating to Subgrade, Soil-Aggregate, and Fill Materials |

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |             |  |
|-------------|--|
| ASTM C 127  | (1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate   |
| ASTM D 698  | (1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.)) |
| ASTM D 1556 | (1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method  |
| ASTM D 2167 | (1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method   |
| ASTM D 2216 | (1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock   |
| ASTM D 2487 | (1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)                         |
| ASTM D 2922 | (1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)                                |

## DEFINITIONS

The term "embankment" as used in these specifications is defined as the earth and rock fill portions of the dam structure and includes all types of earth, rock and filter materials for the dam and cut-off trench, and all other specified or directed earth and rock fills within the limits of the dam. "Compacted fill" includes all fill, except

backfill, deposited in layers and compacted by rolling or tamping. The types of compacted earth fill are:

- a. "Impervious fill" for the cut-off trench, horizontal and inclined impervious blankets and impervious section of the embankment;
- b. "Random fill" adjacent to the impervious section and blankets;
- c. "Pervious fill" forming the upstream and downstream sections of the embankment, and
- d. "Filter drainage layers" forming the horizontal and/or vertical or inclined pervious drainage blankets designed to prevent the detrimental movement of soil particles.
- e. "Fuseplug fill" placed over the emergency spillway notch designed to washout in a controlled manner during spillway operation.

"Uncompacted fill" includes all fill, deposited in layers but not compacted except by the controlled movement of hauling and spreading equipment. "Backfill," as used in these specifications, is defined as that excavation refill which cannot be placed around or adjacent to a structure until the structure is completed or until a specified time interval has elapsed after completion. "Rock Fill" consists of those portions of the embankment where rock riprap is used for erosion protection.

## **GENERAL PROVISIONS**

### **Lines and Grades**

The embankment shall be constructed to the lines, grades and cross sections indicated unless otherwise directed. The District reserves the right to increase or decrease the foundation widths or the embankment slopes or make such other changes in the embankment sections as may be deemed necessary to produce a safe structure. Increases in height of section, made to compensate for shrinkage or consolidation of the embankment material subsequent to the completion of the embankment, will not exceed five (5) percent of the height above the foundation indicated. The end slopes and side slopes of partial fill sections shall not be steeper than one vertical on 2 horizontal or as otherwise specified or shown on the plans. Temporary cut slopes for the construction of the box culvert shall be no steeper than one vertical on 1 horizontal when excavating in the core zone. The cut slopes for the shell zone materials shall be no steeper than one vertical on 2 horizontal.

## Conduct on the Work

The Contractor shall maintain and protect the embankment in a satisfactory condition at all times until final completion and acceptance of all work under the contract. If in the opinion of the Engineer the hauling equipment causes horizontal shears or slick sides, rutting, quaking, heaving, cracking or excessive deformation of the embankment, the Contractor shall limit the type, load or travel speed of the hauling equipment on the embankment. Any approved embankment material which is lost in transit or rendered unsuitable after being placed in the embankment and before final acceptance of the work, shall be replaced by the Contractor in a satisfactory manner and no additional payment will be made therefor. The Contractor shall excavate and remove from the embankment any material which the Engineer considers objectionable and shall also dispose of such material and refill the excavated area as directed, all at no cost to the District. The Contractor may be required to remove, at his own expense, any embankment material placed outside of prescribed slope lines.

## Haul Roads

Haul roads shall be located and constructed as approved. They shall be designed to maintain the intended traffic, to be free draining and shall be maintained in good condition throughout the contract period, unless otherwise directed. Haul roads within the area of contact between the embankment and its foundation and abutments shall be removed and the area shall be treated as specified in paragraph PREPARATION OF FOUNDATION, PARTIAL FILL SURFACE, AND ABUTMENTS.

## Stockpiling from Approved Borrow Sources

When the excavation from approved borrow sources progresses at a faster rate than placement in the fill is being accomplished, such excavated material shall be stockpiled at approved locations until its use is authorized. No payment will be made for such stockpiling nor for the reloading and hauling of this material to its final position in the embankment.

## **PRODUCTS**

## **MATERIALS**

Classification of soils will be in accordance with ASTM D 2487.

## General

The origin of any fill material in no way determines where it may be used in the embankment. Materials for embankment fills shall be secured from required excavations and from the borrow areas indicated. The intention is to use the most suitable materials obtainable from these sources. Material to be wasted will be specifically designated at the time the material is excavated. Materials containing brush, roots, sod or other perishable materials will not be considered suitable. The suitability of the materials shall be subject to approval and their disposition in the embankment will be as directed. The Contractor shall excavate in the borrow areas in the location determined by the Engineer, whenever such control is necessary to obtain the type of material required for the embankment. Mixing or screening of materials during the excavating process at the borrow area may be required.

## Impervious Fill

Material for compacted impervious fill in the core zone of the dam and other areas as shown on the drawings or specified shall consist of clays, silty clays, or clayey silts obtained from the approved borrow areas, commercial sources or required excavation. The material shall be well graded and the gradation shall be as follows:

U.S. STANDARD SIEVE	PERCENT BY WEIGHT, PASSING	
	Upper Limit	Lower Limit
3 inch	100	100
No. 4	100	60
No. 200	60	15

Silts and clays containing sand may be used, if such materials are sufficiently impermeable and suitable for compacting with a tamping or rubber-tired roller. The plasticity index shall be between non-plastic and 25.

Where exposed during construction, it is expected that the existing compacted impervious core zone of the dam will be acceptable for re-use as the impervious material, however all material must still be approved by the Engineer prior to placement in the dam embankment.

## Random Fill

Material for compacted random fill shall consist of any or all types of material which, from the standpoint of compacted stability, are suitable for use in the dam embankment. Soft weathered rock, which breaks up under rolling to form essentially a soil and which compacts without excessive voids, may be used for random fill, if approved.

#### Pervious Fill

Material for compacted pervious fill in the shell zone of the dam and other areas as shown on the plans or specified shall be clean, free draining sand or sand and gravel obtained from natural deposits within borrow areas and from designated excavations or from commercial sources.

U.S. STANDARD SIEVE	PERCENT BY WEIGHT, PASSING	
	Upper Limit	Lower Limit
12 inch	100	100
No. 4	75	25
No. 200	20	0

The plasticity index shall be less than 10.

Where exposed during construction, it is expected that the existing compacted pervious shell zone of the dam will be acceptable for re-use as the pervious material, however all material must still be approved by the Engineer prior to placement in the dam embankment.

#### Uncompacted Fill

Except as otherwise indicated or required, material for uncompacted fill may consist of any or all types of material available from required excavations and designated borrow areas.

#### Backfill

Backfill shall consist of material of a type and quality conforming to that specified for the contiguous embankment fill material, unless otherwise directed.

#### Filter Drainage Layers

Filter materials shall be composed of tough, durable particles; shall be reasonably free from thin, flat and elongated pieces; and shall contain no organic matter nor soft, friable particles in quantities considered objectionable by the Engineer. Filter materials shall consist of sand, gravel, or crushed stone, well graded between the limits specified below:

U.S. STANDARD SIEVE	PERCENT BY WEIGHT, PASSING	
	Upper Limit	Lower Limit
2 inch	100	100
1 inch	100	65
½ inch	85	50
No. 4	65	30
No 10	50	20
No 16	40	0

All points on individual grading curves obtained from representative samples of filter material shall lie between the boundary limits as defined by smooth curves drawn through the tabulated grading limits plotted on a mechanical analysis diagram. The individual grading curves within these limits shall not exhibit abrupt changes in slope denoting skip grading, scalping of certain sizes or other irregularities which would be detrimental to the proper functioning of the filter. At least one test shall be performed on each 50,000 lb delivered to the project site for each gradation band.

#### RIPRAP

#### Rock

Stone classed as "rock" shall be sound; well graded and free draining. Rock shall be obtained from required excavation or from approved commercial sources. Shales unsuitable for use as rock fill, mudstone and other unsuitable excavated material shall be wasted in designated spoil areas.

Stone shall be sound and durable, free from seams and coatings, and of such characteristics that it will not disintegrate when subjected to the action of water. Loss by abrasion shall not exceed 40% at 1,000 revolutions using the Los Angeles abrasion machine, per ASTM C131, Grading B.

Stone shall be of shapes which will form a stable protection structure of the required depth. Rounded boulders or cobbles shall not be used on slopes steeper than 2 to 1. Angular shapes may be used on any slope. Flat or needle shapes will not be acceptable unless the thickness of the piece is more than 1/3 of the length.

Stone for riprap shall have a minimum apparent specific gravity of 2.4 per ASTM C-127.

Waste concrete and sacked concrete shall not be used for riprap.

The gradation shall be based on the median rock diameter, identified as the D<sub>50</sub> class. The D<sub>50</sub> shall be 6" or 12" as specified on the plans and the riprap shall meet the gradation requirements in Tables 1 and 2 below:

**Table 1 - Riprap Gradation, D<sub>50</sub> = 12"**

Median rock diameter	PERCENT BY WEIGHT, PASSING	
	Upper Limit	Lower Limit
24 inch	100	90
18 inch	85	70
12 inch	50	30
8 inch	15	5
4 inch	5	0

**Table 2 - Riprap Gradation, D<sub>50</sub> = 6"**

Median rock diameter	PERCENT BY WEIGHT, PASSING	
	Upper Limit	Lower Limit
12 inch	100	90
9 inch	85	70
6 inch	50	30
4 inch	15	5
2 inch	5	0

#### Filter Layer

Filter layer for riprap construction shall be filter fabric per Section 704 - GEOTEXTILES USED AS FILTERS. A cushion layer of gravel shall be provided over the fabric to prevent tearing when dumping the riprap. Cushion layers for construction of the bedding for riprap shall be a pervious mixture of sand, gravel, and cobbles and not more than 5 percent, by weight, of material passing a No. 200 sieve.

## FUSEPLUG FILL

Fuseplug fill shall be a uniformly graded, fine gravel (pea gravel) which meets the requirements of AASHTO M57-80 and M146-91. The material shall be washed clean and shall exhibit essentially no cohesion under any circumstance.

## EXECUTION

### PREPARATION OF FOUNDATION, PARTIAL FILL SURFACES AND ABUTMENTS

Foundations shall be inspected and approved by ADWR prior to placing any concrete or embankment on the foundation.

#### Earth

After excavation or stripping of the embankment foundation to the extent indicated or otherwise required, the sides of stump holes, test pits, and other similar cavities or depressions shall be broken down, where so directed, so as to flatten out the slopes, and the sides of the cut or hole shall be scarified to provide bond between the foundation material and the fill. Unless otherwise directed, each depression shall be filled with either pervious, random, or impervious, or rock material dependent upon the type of material which is to be placed immediately above the foundation. The fill shall be placed in layers, moistened, and compacted in accordance with the applicable provisions of paragraphs PLACEMENT, MOISTURE CONTROL, and COMPACTION. Materials which cannot be compacted by roller equipment because of inadequate clearances shall be spread in 8 inch layers and compacted with power tampers to an extent equal to that of the contiguous embankment fill material. After filling of depressions and immediately prior to placement of compacted fill in any section of the embankment, the foundation of such section shall be loosened thoroughly by scarifying, plowing, discing or harrowing to a minimum depth of 6 inches, and the moisture content shall be adjusted to the amount specified in paragraph MOISTURE CONTROL for the appropriate type of material, except in areas where this requirement is waived by the Engineer. After removal of roots or other debris turned up in the process of loosening, the entire surface of the embankment foundation area shall be compacted by a minimum of two complete coverages of the compaction equipment as specified for the appropriate type of fill. Prior to placement of compacted fill on or against the surfaces of any partial fill section, all soft or loose material, all material containing cracks or gullies, and all material that does not conform with the specified zoning of the embankment shall be removed. The remaining surface

of the partial fill shall be loosened by scarifying, plowing, discing or harrowing to a minimum depth of 6 inches, and the moisture content shall be adjusted as specified in paragraph MOISTURE CONTROL for the appropriate type of material. The surface of the partial fill section upon which fill is to be placed shall then be compacted as hereinafter specified for the appropriate type of fill. No separate payment will be made for loosening and rolling the foundation area, the abutment area, or the surfaces of partial fill sections, but the entire cost thereof shall be included in the applicable contract price for fill.

## Rock

All rock surfaces upon which or against which embankment materials are to be placed shall be cleaned in accordance with the applicable provisions of Section 204 FOUNDATION PREPARATION. Prior to the placement of embankment material upon or against a rock surface, all open joints and cracks in that surface shall be filled with mortar to the depths cleaned. Those portions of such rock surfaces where, in the opinion of the Engineer, the compaction of the embankment materials cannot be accomplished satisfactorily with power tampers or other specified compaction equipment, shall be filled with mortar or concrete as directed to the extent necessary to permit satisfactory use of the compaction equipment. In no case shall a thin coat of mortar be left on smooth, intact rock surfaces. Large rock overhangs and protrusions shall be removed by the use of pre-splitting or line drilling techniques in such a manner as to minimize damage to the underlying rock, or the spaces beneath overhangs and around protrusions shall be filled with tamped concrete so that satisfactory compaction of embankment materials can be accomplished. Vertical surfaces shall not be more than five (5) feet in height.

## Benching

Where construction of embankment materials against existing slopes occurs, the existing slope shall be cut a minimum of 2.0 feet horizontally as the fill is brought up in 6 - 8 inch lifts. The material cut out shall be compacted to the same density as the fill material.

## PLACEMENT

### General

Quality assurance and acceptance testing of compacted embankments will be conducted by the DISTRICT. Testing shall be performed by an approved commercial testing laboratory. Testing shall conform to Section 203 -

EARTHWORK, paragraph TESTING. No fill shall be placed on any part of the embankment foundation until such areas have been inspected and approved.

The gradation and distribution of materials throughout the compacted earth fill section of the dam shall be such that the embankment will be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material of the same class. Successive loads of material shall be dumped at locations on the fill as directed or approved. No fill shall be placed upon a frozen surface, nor shall snow, ice, or frozen earth be incorporated in the embankment.

#### Rate of Placement

Unless otherwise directed, the embankment shall be maintained at approximately the same level regardless of the number of types of materials being placed, except that rock fills and the adjoining filter blankets shall be placed with sufficient lag to prevent mixture of embankment and filter blanket and/or rock materials.

#### Impervious Fill

Impervious fill shall be placed in the impervious section. In general, the more impervious materials shall be placed towards the center of the impervious section and the less impervious materials toward the random or pervious sections so that a transition in permeability is effected from the core to the random or pervious sections.

Where the impervious material is in contact with the existing clay core, the initial lift of impervious material shall be mixed with the existing moisture conditioned core material prior to compaction to ensure a good bond and no lift lines subject to seepage. Each subsequent lift shall be scarified prior to placement of the next lift.

#### Random Fill

Random fill shall be placed in the random sections of the embankment. Except as specified below, limits of random sections shown indicate the maximum extent of random material. When approved, pervious material may be substituted for random material in areas where random sections adjoin pervious sections. In general, the more impervious of the random material shall be placed toward the impervious section or blanket and the more pervious of the random material shall be towards the outer edge of the random section so that a transition in permeability

is effected from the impervious section to the pervious section or outer portions of the embankment.

#### Pervious Fill

Pervious fill shall be placed in the pervious sections of the embankment. In general, the pervious sections of embankment shall be placed with the less pervious material near the random or impervious sections of the embankment and the more pervious materials near the outer slopes of the embankment.

#### Filter Drainage Layers

Sand and gravel filters shall be placed in the embankment in the manner described and to the lines and grades indicated. Tolerance of plus or minus 1 inch will be allowed.

#### Riprap

Riprap shall be placed as shown on the plans and shall be constructed of durable rock dumped and bulldozed into place in not greater than 2 foot lifts to the lines and grades shown, or as staked in the field, and in such manner as to produce a reasonably well graded mass with the smaller stones adjacent to the filter material and the larger sizes on the outer slopes of the embankment with no objectionable pockets of small stones or clusters of larger stones. The placing shall be supplemented by such hand methods as are required to obtain even surfaces on the outside faces. A tolerance of plus 12 inches and minus 3 inches from the slope lines and grades shown will be allowed in the finished surfaces of the rock fills, except that the extreme minus tolerance shall not be continuous over an area greater than 200 square feet. All bridging in rock fills shall be broken as well as all slabs and slabby rock. Special care shall be exercised in placing rock fill in all areas within 3 feet of structures to avoid damage to such structures.

#### Spreading

After dumping, the materials shall be spread by bulldozers or other approved means in approximately horizontal layers over the entire fill areas. Unless otherwise directed, the thickness of these layers before compaction with tamping type rollers shall not be more than 6 - 8 inches for impervious materials nor more than 12 inches for other embankment materials, except backfill which shall be spread in accordance with paragraph BACKFILL. Unless otherwise directed, the thickness of layers before compaction with rubber-tired rollers shall not be more

than 8 inches for impervious materials, nor more than 12 inches for other embankment materials except backfill. Pervious fill and filters shall be spread in layers not more than 12 inches in thickness. As soon as practicable after commencement of construction of any section of the embankment, the central portion thereof shall be raised or crowned with grades not to exceed 5 percent so that the surface of the fill will drain freely and shall be so maintained throughout construction. If the compacted surface of any layer of material, exclusive of filter material and rock fill, is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or by any other approved method, before the succeeding layer is placed thereon. During the dumping and spreading processes, the Contractor shall maintain at all times a force of men adequate to remove all roots and debris from all embankment materials and all stones of greater than 3 inches in maximum dimension from impervious materials and greater than 12 inches in maximum dimension from pervious materials, except rock fill. Stone so removed shall be placed in the outer slopes of the rock fill and the roots and debris shall be removed from the embankment and disposed of in an approved manner. The entire surface of any section of the embankment under construction shall be maintained in such condition that construction equipment can travel on any part of any one section. Ruts in the surface of any layer shall be removed by scarifying before placing and compacting additional material.

## **MOISTURE CONTROL**

The materials in each layer of the fill shall contain the amount of moisture, within the limits, specified below or as directed by the Engineer, necessary to obtain the specified compaction. Material that is not within the specified limits after compaction shall be reworked, regardless of density.

### **Impervious Sections**

The moisture content after compaction shall be as uniform as practicable throughout any one layer of impervious materials. The moisture content after compaction as determined by ASTM D 2216 shall be within the limits of 3 percentage points above optimum and 1 percentage points below optimum moisture content. Material that is too wet shall be spread on the embankment and permitted to dry, assisted by discing or harrowing, if necessary, until the moisture content is reduced to an amount within the specified limits. When the material is too dry, the Contractor will be required to sprinkle each layer on the fill. Harrowing, or other approved methods will be required to work the moisture into the material until a uniform distribution of moisture is obtained. Water applied on a layer of fill shall be accurately controlled in amount so that free water will not appear on the surface during or subsequent to rolling. Should too much water be added to any part of the embankment, so that the material is too wet to obtain the desired

compaction, the rolling on that section of the embankment shall be delayed until the moisture content of the material is reduced to an amount within the specified limits. If it is impracticable to obtain the specified moisture content by wetting or drying the material on the fill, the Contractor may be required to prewet or dry back the material at the sources of excavation. If, in the opinion of the Engineer, the top or contact surfaces of the partial fill section become too dry to permit suitable bond between these surfaces and the additional fill to be placed thereon, the Contractor shall loosen the dried materials by scarifying or discing to such depths as may be directed; he shall dampen the loosened material to an acceptable moisture content; and he shall compact this layer in accordance with the applicable requirements of paragraph COMPACTION, subparagraph IMPERVIOUS FILL, to densities comparable to the underlying embankment.

#### Random Sections

The upper and lower limits of moisture content, and the moisture control procedures for random materials shall be the same as that specified for impervious material, or pervious material, dependent upon which of these types it most nearly resembles.

#### Pervious Section

Pervious material shall be wetted by sprinkling after spreading on the embankment and the moisture content of each layer shall be maintained at the optimum for compaction during rolling. Prewetting of pervious material at the sources of excavation or borrow will not be required. Sprinkling shall be done with hoses connected to header pipes along the faces of the embankment, by water trucks with pressure spray bars, or by any other approved method. All connections in the water supply system, including the hose connections to the header pipes, shall be watertight. Jets shall not be directed at the embankment with such force that the finer materials will be washed out. The capacities of pumps and sizes of header pipes shall be sufficient to supply the required amount of water at all times.

#### Filter Drainage Layers

Moisture control of graded sand and gravel filter and bedding layers will not be required and sluicing will not be permitted. Moisture control of filters containing a predominate amount of sand particles will be as required for pervious materials specified in paragraph PERVIOUS SECTION.

## Fuseplug Fill

Moisture control of fine gravel fill for the fuseplug will not be required and sluicing will not be permitted.

## Riprap

No moisture control will be required for construction of riprap.

## COMPACTION

### Equipment

Compaction equipment shall conform to the following requirements and shall be used as prescribed in subsequent paragraphs.

### Tamping Rollers

a. Towed - Tamping rollers shall consist of two or more non-vibratory roller drums mounted side-by-side in a suitable frame and towed by either a crawler-type or rubber tired tractor having sufficient power to pull the roller satisfactorily when the drums are fully ballasted. Each drum shall be free to pivot about an axis parallel to the direction of travel. Rollers operated in tandem sets shall be controlled in a manner such that the prints produced by the tamping feet of the tandem units are staggered. Each drum of a roller shall have an outside diameter of not less than 5 feet and shall be not less than 5 feet in length. The space between two adjacent drums, when on a level surface, shall not be less than 12 inches nor more than 15 inches. At least one tamping foot shall be provided for each 2 square feet of drum surface. The length of each tamping foot from the outside surface of the drum shall be not more than 11 inches and shall be maintained at not less than 9 inches. The bearing surface of each tamping foot shall be flat with a surface area not less than 7 square inches nor more than 10 square inches. During the operation of rolling, the spaces between the tamping feet shall be maintained clear of materials which would impair the effectiveness of the tamping rollers. The weight of a roller when fully loaded shall be not less than 4,000 pounds per foot of drum length, and the weight of a roller empty shall be not more than 2,500 pounds per foot of drum length. The bearing surface, tamping foot size, the drum loading, and the operation of the rollers shall be as required to obtain the desired compaction. If more than one roller is used on

any one layer of fill, all rollers so used shall be of the same type and essentially of the same dimensions. Rollers shall be drawn by crawler-type or rubber-tired tractors at a speed not to exceed 5.0 mph. The use of rubber-tired towing equipment shall be discontinued if the tires leave ruts that prevent uniform compaction by the tamping roller, and the substitution of crawler-type towing equipment may be directed.

b. Self-propelled - The use of self-propelled non-vibratory tamping rollers conforming with the following specification will be permitted, and their design and operation shall be subject to approval, and subject to the right, at any time during the prosecution of the work, to direct such modifications to the tamping feet or variations in roller drum weight where applicable, as may be found necessary to secure optimum compaction of the earth fill materials. If use of self-propelled tamping rollers causes shearing of the fill, laminations in the fill, or results in inadequate compaction, the Engineer may direct that such rollers be removed from the fill and that appropriate towed tamping rollers be used. Two-or three-drum side-by-side units that are either in drive position or drawn by separate power equipment shall have a clearance between adjacent drums not less than 12 inches nor more than 15 inches. Two-drum or four-drum equipment separated by cab and differential and arranged in tandem must have its static weight equally distributed to all compaction drums and must have the tandem drums positioned such that the prints of the tamping feet produced by the tandem drums are staggered. The surface on which the tamping feet are mounted shall have a minimum outside diameter of 4 feet and at least one tamping foot for each 2 square feet of drum surface. The distance between the centers of any two adjacent tamping feet shall be not less than 9 inches. The length of each tamping foot from the outside mounting surface of the drum shall be not more than 11 inches and shall be maintained at not less than 9 inches. The bearing surface of each tamping foot shall be flat and have a surface area not less than 7 square inches nor more than 14 square inches. Cupped recesses within the bearing surface of each tamping foot will be permitted but shall not exceed 0.5 inches in depth. During rolling operations, the spaces between the tamping feet shall be maintained clear of materials which would impair the effectiveness of the tamping roller. The weight of all roller drums during compaction of fill materials shall be maintained uniform and with the weight per foot of drum length not less than 4,300 pounds. For self-propelled rollers in which steering is accomplished through the use of rubber-tired wheels, the tire pressure shall not exceed 40 psi. The use of the compactor shall be discontinued if the tires leave ruts that prevent uniform compaction by the tamping roller and the substitution of appropriate towed tamping rollers may be directed. When a self-propelled roller is provided with a dozer blade, coverages made with the blade in operation shall not be counted as compaction coverages. Self-propelled rollers shall be operated at a speed not to exceed 5.0 mph.

#### Vibratory Rollers

Vibratory rollers for compacting rock fills, pervious sand and gravel fills, or filter and transition drainage layers shall be equipped with a smooth steel compaction drum and shall be operated at a frequency of vibration during compaction operations between 1100 and 1500 vpm. Vibratory rollers may be either towed or self-propelled and shall have an unsprung drum weight that is a minimum of 60 percent of the rollers' static weight. Towed rollers shall have at least 90 percent of their weight transmitted to the ground through the compaction drum when the roller is standing in a level position hitched to the towing vehicle. Rollers for compacting rock fill shall have a minimum static weight of 20,000 pounds, a minimum dynamic force of 40,000 pounds when operating at 1400 vpm, and an applied force not less than 9,000 pounds per foot of compaction drum length. Rollers for compacting sand and gravel fills or filter and drainage layers shall have a minimum static weight of 8,000 pounds, a minimum dynamic force of 16,000 pounds when operating at 1400 vpm, and an applied force not less than 5,000 pounds nor greater than 9,000 pounds per foot of compaction drum length. The level of amplitude and vibration frequency during compaction will be maintained uniform throughout the embankment zone within which it is operating. Rollers shall be operated at speeds not to exceed 1.5 mph. The equipment manufacturer shall furnish sufficient data, drawings, and computation for verification of the above specifications, and the character and efficiency of this equipment shall be subject to approval.

#### Rubber-tired Rollers

Rubber-tired rollers shall have a minimum of four wheels equipped with pneumatic tires. The tires shall be of such size and ply as can be maintained at tire pressures between 80 and 100 psi for a 25,000 pound wheel load during rolling operations. The roller wheels shall be located abreast and be so designed that each wheel will carry approximately equal load in traversing uneven ground. The spacing of the wheels will be such that the distance between the nearest edges of adjacent tires will be greater than 50 percent of the tire width of a single tire at the operating pressure for a 25,000 pound wheel load. The roller shall be provided with a body suitable for ballast loading such that the load per wheel may be varied, from 18,000 to 25,000 pounds. The roller shall be towed at speeds not to exceed 5 mph. The character and efficiency of this equipment shall be subject to approval.

#### Power Tampers

Compaction of material, in areas where it is impracticable to use a roller or tractor, as provided in paragraph EARTH, shall be performed by the use of approved power tampers.

## Impervious and Random Fill

After a layer of impervious or random fill material has been dumped and spread, it shall be harrowed if required, to break up and blend the fill materials, unless harrowing, as specified under paragraph IMPERVIOUS SECTIONS, is performed to obtain uniform moisture distribution. Harrowing shall be performed with a heavy disc plow, or other approved harrow, to the full depth of the layer. If one pass of the harrow does not accomplish the breaking up and blending of the materials, additional passes of the harrow may be required, but in no case will more than three passes of the harrow on any one layer be required for this purpose. When the moisture content and the condition of the layer is satisfactory, the lift shall be compacted to at least 95 percent of maximum density as determined by ASTM D 698, prior to placement of the next layer. Determination of in-place density shall be in accordance with ASTM D 1556, ASTM D 2167, and ASTM D 2922. Portions of the fill which are not accessible to the roller shall be placed in 8 inch layers loose measurement and compacted with power tampers to a degree equal to that obtained on the other portions of the compacted fill by rolling as specified. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section when there is sufficient area to permit these operations to proceed simultaneously.

## Pervious Fill

After each layer of pervious material has been dumped and spread, and the moisture content is in accordance with the provisions of paragraph PERVIOUS SECTION, the entire surface of the layer shall be compacted to an average of 95 percent minimum relative density.

## Additional Rolling for Compaction

If, in the opinion of the Engineer, the desired compaction of any portion of the embankment is not secured by the minimum number of coverages specified, additional complete coverages shall be made over the surface area of such designated portion until the desired compaction has been obtained.

## Filter and Transition Drainage Layers

The requirements for compacted pervious fills will apply to these materials except for bedding layers under dumped riprap. Bedding layers under dumped riprap will

require no special compaction other than controlled movement of dumping and spreading equipment.

#### Fuseplug Fill

The requirements for compacted pervious fills will apply to these materials.

#### Repair of Erosion Damage

The requirements for compacted pervious fills will apply to these materials.

#### Riprap

Compaction other than that obtained by the controlled movement of the hauling and spreading equipment over the area will not be required.

### **UNCOMPACTED FILL**

Material from required excavations and from the designated borrow areas shall be placed in the berms/dikes upstream and downstream from the dam embankment, as indicated or otherwise required. The fill shall be dumped and spread in horizontal layers not to exceed 24 inches in thickness. Compaction other than that obtained by the controlled movement of the hauling and spreading equipment over the area will not be required.

### **BACKFILL**

#### General

No backfill or other load shall be placed on or against concrete surfaces within the dam and spillway until the concrete has achieved 70% of the design compressive strength and in no case prior to 14 days after placement.

Before passage of hauling and rolling equipment over the top of the conduit or other structure will be permitted, the depth of fill over the concrete shall be sufficient to permit such passage without inducing harmful stresses or vibrations in the structure.

## Placement

Backfill shall be placed in 8 inch layers and thoroughly compacted. Unless otherwise directed, the placing and compacting of all backfill material and the control of its moisture content shall conform to the applicable provisions of paragraphs PLACEMENT, MOISTURE CONTROL, and COMPACTION. Fill in back of wing walls shall be kept at approximately the same elevations as that of the backfill, gravel blankets, riprap, or derrick stone on the opposite side of the wall until placement has reached the maximum elevation of the materials to be placed on the toe of the wall. Drainage openings through walls shall be kept open at all times.

## SLIDES

In the event of slides in any part of the embankment prior to final acceptance of the work the Contractor shall remove material from the slide area, as directed, and shall rebuild such portion of the embankment. In case it is determined that the slide was caused through the fault of the Contractor the removal and disposal of material and the rebuilding of the embankment shall be performed without cost to the District; otherwise this work will be paid for at the applicable contract unit prices for borrow excavation and compacted fill or backfill.

## MEASUREMENT AND PAYMENT

Embankment fill and backfill to be measured for payment shall include the following:

- embankment fill to raise the dam
- backfill of the trench through the dam to construct the box culvert
- fill to construct the sand diaphragm
- fill and backfill including erodible fuseplug material on the emergency spillway
- riprap erosion protection
- backfill over gabion and riprap erosion protection
- fill to construct dikes and berms
- repair erosion damage on downstream face of dam

No separate payment will be made for other miscellaneous embankment or backfill not specifically included in the items listed above or in other bid items elsewhere in the specifications and the cost of this fill shall be included in the cost of the appurtenant work.

Payment will be made for costs associated with preparing the foundation of the embankment; spreading, harrowing, sprinkling, compacting, removing objectionable materials; and all other incidental work required for the construction, protection, and maintenance of the embankment fill and backfill of all material types and zones. No separate payment will be made for uncompacted fill and all costs incidental to spreading, protecting, and maintenance of such fill shall be included in the contract price for excavation of the material.

Compacted fill will be measured for payment in place based upon the established limit lines and the payment lines indicated on the cross sections shown or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation and accomplishment of foundation preparation (except scarifying) and the lines, grades and slopes of the accepted embankment.

Unit of measure: cubic yard, measured to the nearest 1 yard.

**ITEM 205-1 - COMPACTED FILL, IMPERVIOUS**

**ITEM 205-2 - COMPACTED FILL, PERVIOUS**

**ITEM 205-3 - COMPACTED FILL, RANDOM**

Payment will be made for costs associated with mixing the materials to the required gradation, spreading, compacting, removing objectionable materials, and all other incidental work required for the construction, protection, and maintenance of the filter.

Filters will be measured for payment in place based upon the established limit lines and the payment lines indicated on the cross sections shown or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation and accomplishment of foundation preparation (except scarifying) and the lines, grades and slopes of the accepted embankment.

Unit of measure: cubic yard, measured to the nearest 1 yard.

**ITEM 205-4 - FILTER, SAND**

Payment for riprap construction shall be on the basis of the price bid per cubic yard, and shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in constructing the riprap complete in place as specified on the plans, and in the special provisions. This includes, but is not limited to, preparation of ground surfaces and trenching, dewatering, furnishing and placing of riprap. No separate payment will be made for furnishing and placing gravel cushion material to protect the filter fabric, the cost shall be included in the unit price for construction of the riprap.

Riprap will be measured for payment in place based upon the established limit lines and the payment lines indicated on the cross sections shown or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation and accomplishment of foundation preparation (except scarifying) and the lines, grades and slopes of the accepted embankment.

Unit of measure: cubic yard, measured to the nearest 1 yard.

**ITEM 205-5 - RIPRAP  $D_{50} = 12''$**

**ITEM 205-6 - RIPRAP  $D_{50} = 6''$**

Payment will be made for costs associated with furnishing the materials to the required gradation, spreading, compacting, removing objectionable materials, and all other incidental work required for the construction, protection, and maintenance of the fuseplug fill.

Fuseplug fill will be measured for payment in place based upon the established limit lines and the payment lines indicated on the cross sections shown or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation and accomplishment of foundation preparation (except scarifying) and the lines, grades and slopes of the accepted embankment.

Unit of measure: cubic yard, measured to the nearest 1 yard.

**ITEM 205-7 - FUSEPLUG FILL**

Payment will be made for costs associated with furnishing the materials, spreading, compacting, removing objectionable materials, and all other incidental work required for the repair of the erosion damage on the downstream face of the dam embankment.

Measurement will be by the square yard, measured to the nearest 1 square yard.

## ITEM 205-8 - REPAIR EROSION DAMAGE ON DAM

### EARTHWORK ADJUSTMENTS:

Neither variations in shrink or swell of material from those shown on plans, nor variations of shrink or swell from Contractor obtained sources will be reason for establishing a quantity adjustment.

Adjustments in earthwork quantities due to revisions ordered by the Engineer will be isolated by measurement or calculations. The bidding schedule quantities will be adjusted by the amount of the ordered change and will not be included in any other adjustment of the bidding schedule quantities as specified in this subsection.

## SECTION 221 - WIRE MESH GABIONS

### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02371 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Work within this section shall consist of constructing gabion erosion protection on the emergency spillway.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 90/A 90M

(1995a) Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

- ASTM A 185 (1990a) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
- ASTM A 239 (1989) Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
- ASTM A 313/A 313M (1995a) Stainless Steel Spring Wire
- ASTM A 641/A 641M (1997) Zinc-Coated (Galvanized) Carbon Steel Wire
- ASTM A 764 (1990) Steel Wire, Carbon, Drawn Galvanized and Galvanized at Size for Mechanical Springs
- ASTM A 853 (1993) Steel Wire, Carbon, for General Use
- ASTM B 6 (1987) Zinc
- ASTM B 117 (1990) Salt Spray (Fog) Testing

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

M281-94 Steel Fence Posts and Assemblies, Hot-Wrought

**GENERAL REQUIREMENTS**

The work under this specification includes furnishing, assembling, anchoring, filling, and tying wire mesh rectangular compartmented gabions placed on a prepared surface of geotextile as specified herein, and in accordance with the lines, grades, and dimensions shown on the drawings or otherwise established in the field by the Engineer.

**SUBMITTALS**

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110:

SD-13 Certificates

Gabions; FIO  
Alternative Wire Fasteners for Gabions; FIO  
Steel posts; FIO

For each shipment of materials to the site, the Contractor shall furnish the Engineer, in duplicate, a manufacturer's certificate or affidavit signed by a legally authorized official from the company manufacturing the gabion units and wire fasteners and anchor posts, that all material contained within that shipment meets the composition, physical, and manufacturing requirements stated in this specification.

## **DESCRIPTION**

Gabion units shall consist of compartmented rectangular basket or mattress type containers filled with stone. Twisted wire mesh shall be used. Baskets shall be fabricated from galvanized steel wire formed into a nonraveling mesh. Steel anchor posts shall be used to anchor the baskets to the slope.

## **PRODUCTS**

### **Gabions**

#### **Steel Twisted Wire Mesh Gabions**

Gabion basket units shall be of nonraveling construction and fabricated from a double twisted hexagonal wire mesh. The size of mesh openings shall be approximately 3 1/4 inches by 4 1/2 inches. The gabion mesh wires shall be wrapped around the selvage wire no less than 1 1/2 times and shall interconnect with adjacent mesh wires. All steel wire used shall be galvanized prior to fabrication into mesh. All gabion diaphragm and frame wire shall equal or exceed ASTM A 641/A 641M, ASTM A 809, ASTM A 818, and ASTM A 853, and possess soft tensile strength of 60,000 pounds per square inch (psi) with a tolerance of minus 2,000 psi. The galvanized wire shall have a Finish 5, Class 3, zinc coating, as indicated in ASTM A 641/A 641M. The weight of coating shall be determined by ASTM A 90/A 90M. The grade of zinc used for coating shall be High Grade or Special High Grade as prescribed in ASTM B 6, Table 1. The uniformity of coating shall equal or exceed four 1-minute dips by the Preece Test, as determined by ASTM A 239. Wire used for lacing or as internal connecting wire within basket cells may have soft tensile strength designation. As an alternative to lacing, wire fasteners may be used.

All wire used for gabion baskets, selvage and lacing wire shall meet the following nominal minimum requirements:

**GALVANIZED WIRE**

TYPE OF WIRE	WIRE DIAMETER AFTER COATING (inches)	COATING WEIGHT (oz/sq ft)	TENSILE STRENGTH (psi)
Mesh Wire	0.120	0.85	60,000
Selvage Wire	0.150	0.85	60,000
Lacing Wire or Internal Connecting Wire	0.087	0.70	60,000

Gabion mesh and connections require the following minimum strength:

	STRENGTH POUNDS PER LINEAR FOOT
Wire mesh strength (pulled parallel to wire twists)	2,000
Wire mesh strength (pulled perpendicular to wire twists)	1,000
Connection of selvage wire to mesh	1,400
Connection of end panel to base	1,200
Connection of diaphragm	600

**Alternative Wire Fasteners for Gabions**

**General**

Subject to approval of the Engineer, wire fasteners including interlocking fasteners, ring fasteners, twist ties, and spiral binders may be used in lieu of lacing wire. When seeking such approval, the Contractor shall demonstrate to the satisfaction of the Engineer:

- a. That the proposed fastener system can consistently produce a joint with a strength of 1,400 pounds per lineal foot when tested in accordance with paragraph PULL-APART RESISTANCE TEST;
- b. That the proposed fastener system does not cause damage to the protective coating on the wire;
- c. That the Contractor has the proper equipment and trained employees to correctly install the fasteners; and
- d. That proper installation can be readily verified by visual inspection.

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required, the number and size of wires that fastener is capable of properly joining, and a description of a properly installed fastener, including drawings or photographs if necessary. A properly installed fastener shall meet the same requirements as that specified for the fasteners in the paragraph SALT SPRAY TEST. If gages or other aids are needed to verify the proper installation of the fasteners, the Contractor shall furnish the District such gages or aids, in such number as may reasonably be required, for the use of District inspectors. If more than one wire fastener is proposed (e.g. different gage or length of wire) for different joints, the fasteners shall be readily distinguishable. Alternate wire fasteners shall not be used to join more wires, or larger wires, than for which they were tested and approved. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvage or edge wire. Alternate wire fasteners shall not be used to close basket lids unless specifically approved for that purpose. When seeking approval to use alternate wire fasteners to close basket lids, the Contractor shall demonstrate to the satisfaction of the Engineer that the fasteners can be properly installed on a properly filled gabion without stretching the gabion to the point that the gabion, or the protective wire coating, is damaged.

### **Wire Fasteners Materials**

Galvanized wire fasteners shall be used with galvanized gabions. Galvanized wire fasteners, except twist tie and spiral binder fasteners, shall conform to ASTM A 764, Finish 1 with Type III coating. Twist tie or spiral binder fasteners shall meet the requirements of lacing wires as specified in paragraph STEEL TWISTED WIRE MESH GABIONS.

### **Testing**

Test records made within 5 years by certified laboratories and Government agencies will be used to determine the acceptability of wire fasteners. Samples of wire fasteners with their certified test records shall be submitted at least 60 days in advance to the Engineer for approval. The District reserves the right to test additional samples to verify the submitted test records at the District's expense. When the first test results indicate that the fasteners do not meet the specified requirements, the additional test will be at the Contractor's expense. The fasteners will be rejected after two tests failing to meet the requirements. All types of fasteners including fasteners made of stainless steel shall be subject to the salt spray test and pull-apart resistance test.

a. Salt Spray Test - A set of two identical rectangular gabion panels, each with a width about 10-1/2 mesh openings along a selvage wire, shall be jointed by properly installed wire fasteners along the two selvage wires so that each fastener confines two selvage and two mesh wires. If the fasteners are also to be used to joint two individual empty gabion baskets, two additional selvage wires which are each mechanically wrapped with mesh wires shall be included so that each fastener confines four selvage and four mesh wires. The set of the jointed panels shall be subject to salt spray test, ASTM B 117, for a period of not less than 48 hours. At the end of the test, the fasteners, the selvage, or mesh wires confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends. A properly installed fastener shall meet the following requirements:

- (1) Each interlocking fastener shall be in a locked and closed position.
- (2) Each ring fastener shall be closed, and the free ends of the fastener shall overlap a minimum of 1 inch.
- (3) Each twist tie shall be closed and maintain a minimum of two full turns.
- (4) The spiral binder shall be tied at both ends.

b. Pull-Apart Resistance Test - A new set of the jointed panels, which are prepared by the same method as specified in the salt spray test but without being subject to the 48-hour salt spray test, shall be mounted on a loading machine with grips or clamps such that the panels are uniformly secured along the full width. The grips or clamps shall be designed to transmit only tension forces. The load will then be applied at a uniform rate of 50 pounds per second until failure occurs. The failure is defined as when the maximum load is reached and a drop of strength is observed with subsequent loading or the opening between any two closest selvage wires, applicable to a fastener confining either two or four selvage wires, becomes greater than 2 inches at any place along the panel width. The strength of the jointed panels at failure shall have a minimum of 1,400 pounds per linear foot.

## Stone Fill

### Quality

Stone shall be durable and of suitable quality to ensure permanence in the structure and climate in which it is to be used. It shall be free of cracks, seams, and other defects that would tend to increase unduly its deterioration from natural causes or reduce its size to that which could not be retained in the gabion baskets. The inclusion of more than 5% by weight of dirt, sand, clay, and rock fines will not be permitted. The sources from which the Contractor proposes to obtain the material shall be selected well in advance of the time when the material will be required in the work. Suitable samples of stone fill material shall be collected in the presence of a District representative and submitted to the Engineer for approval prior to delivery of any such material to the site of the work. Unless otherwise specified, all test samples shall be obtained by the Contractor and delivered at his expense to the Engineer at least 15 days in advance of the time when the placing of the stone-filled gabions is expected to begin. Suitable tests and/or service records will be used to determine the acceptability of the stone. In the event suitable test reports and service records are not available, as in the case of newly operated sources, the material shall be subjected to such tests as are necessary to determine its acceptability for use in the work. Tests to which the material may be subjected include petrographic analysis, specific gravity, absorption, wetting and drying, freezing and thawing, and such other tests as may be considered necessary to demonstrate to the satisfaction of the Engineer that the materials are acceptable for use in the work. All tests will be made by or under the supervision of the District and at its expense.

#### Testing requirements for imported stone fill material

Test	Acceptable Values
(1) Unit Weight of Stone (surface dry)	$\geq 2560$ kg/cu m (160 lb/ft <sup>3</sup> )
(2) Absorption	$\leq 5.0\%$
(3) Abrasion (500 revolutions)	$\leq 20.0\%$ loss
(4) Wetting and Drying (30 to 80 cycles depending on local climate)	No major progressive cracking, scaling, or disaggregation

Test	Acceptable Values
(5) Freezing and Thawing (10 to 100 cycles, depending on local conditions)	<math>\leq 10.0\%</math> loss for 12 cycles <math>\leq 15.0\%</math> loss for 100 cycles
(6) Magnesium Sulfate Soundness (5 cycles)	<math>\leq 15.0\%</math>

### Gradation

Stone fill used in the gabions shall be a well-graded mixture with sizes ranging between 4 inches and 12 inches, based on US Standard square mesh sieves. The gradation shall meet the requirements in the following table.

#### Rock Gradation for Gabions

Median Rock Diameter	Percent By Weight, Passing	
	Upper Limit	Lower Limit
12 inch	100	90
9 inch	85	70
6 inch	50	30
4 inch	15	5
2 inch	5	0

No stone shall have a maximum dimension greater than 12 inches in any direction. The ratio of the maximum dimension to the minimum dimension of any rock shall not be greater than two. Processed rock shall be stockpiled and shall be approved by the Engineer prior to delivery to the site.

### Filter Material

Filter fabric shall meet the provisions of Section 222 - GEOTEXTILES USED AS FILTERS

### Anchor Posts

Posts for anchors shall be galvanized hot wrought steel as specified in AASHTO M281-94 and steel shall be type A, B or C. Posts shall be a minimum of 8 feet long and furnished with an anchor plate.

## **EXECUTION**

### **FOUNDATION PREPARATION**

Foundation preparation shall be performed as specified in Section 203 - EARTHWORK.

## **FABRICATION**

### **Galvanized Steel Wire Mesh Gabions**

Gabions shall be fabricated in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into rectangular baskets of the sizes specified and shown on the drawings. Gabions shall be of single unit construction, i.e., the base, ends, and sides shall be either woven into a single unit, or one edge of these members connected to the base section of the gabion in such a manner that the minimum strengths of the wire mesh and connections as stated in paragraph MATERIALS are met. Where the length of the gabion exceeds one and one-half its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gage as the body of the gabions, into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary. All perimeter edges of the mesh forming the gabion shall be securely selvaged so that the joints formed by tying the selvages have at least the strengths as specified in paragraph MATERIALS. In addition, the selvaged edges shall be so wrapped and reinforced with the mesh ends that the selvage wire will not be deformed locally about the lacing wire or wire fasteners when baskets are filled or during lid closing. Lacing wire, connecting wire, and/or wire fasteners shall be supplied in sufficient quantity for securely fastening all diaphragms and edges of the gabion.

## **ASSEMBLY AND INSTALLATION**

## Gabion Units

Empty gabion units shall be assembled individually and placed on the approved surface to the lines and grades as shown on the drawings or as directed by the Engineer, with the sides, ends, and diaphragms erected in such a manner to ensure the correct position of all creases and that the tops of all sides are level. Filling of gabion units in one place and then transporting them to their final position in the work will not be permitted. All gabion units shall be properly staggered horizontally and vertically as shown on the drawings. Finished gabion structure shall have no gaps along the perimeter of the contact surfaces between adjoining gabion basket units.

All adjoining empty gabion units shall be connected by lacing wire/or wire fasteners along the perimeter of their contact surfaces in order to obtain a monolithic structure. Lacing of adjoining basket units shall be accomplished by continuous stitching with alternating single and double loops at intervals of not more than 5 inches, and a half hitch shall be included at every double loop. All lacing wire terminals shall be securely fastened. Wire fasteners may be used in lieu of lacing wire for forming individual baskets and joining empty baskets together prior to stone filling. All joining shall be made through selvage-to-selvage or selvage-to-edge wire connection; mesh-to-mesh or selvage-to-mesh wire connection is prohibited except in the case where baskets are offset or stacked and selvage-to-mesh or mesh-to-mesh wire connection would be necessary. Wire fasteners shall not be used to tie or join stone-filled baskets, unless approved by the Engineer. Each wire fastener shall be properly installed and closed as specified in paragraph ALTERNATIVE WIRE FASTENERS FOR GABIONS, subparagraph TESTING, sub-subparagraph SALT SPRAY TEST. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvage or edge wire.

The initial line of basket units shall be placed on the prepared filter layer, filter fabric or cushion material surface and partially filled to provide anchorage against deformation and displacement during filling operations. After adjoining empty basket units are set to line and grade and common sides with adjacent units thoroughly laced or fastened, they shall be placed in tension and stretched to remove any kinks from the mesh and to a uniform alignment. The stretching of empty basket units shall be accomplished in such a manner as to prevent any possible unraveling.

Stone filling operations shall carefully proceed with placement by hand or machine so as not to damage galvanized wire coating or geotextile filter fabric, to assure a minimum of voids between the stones, and the maintenance of alignment throughout the filling process. Undue deformation and bulging of the mesh shall be corrected prior to further stone filling. To avoid localized deformation, the basket units in any row are to be filled in stages and at no time shall any cell be filled to a depth exceeding 1 foot more than the adjoining cell. The maximum height from which the stone may be dropped into the basket units shall be 36 inches. For

gabion units in excess of 2 feet in height, two uniformly spaced internal connecting wires shall be placed between each stone layer in all front and side gabion units, connecting the back and the front faces of the compartments. Connecting wires or alternatively the preformed stiffeners shall be looped around two twisted wire mesh openings at each basket face and the wire terminals shall be securely twisted to prevent their loosening. For twisted wire gabions, the internal connecting wires or preformed stiffeners are installed as shown on the drawings. The last layer of stone shall be uniformly overfilled 1 to 2 inches to compensate for the future settlement in rock but still allow for the proper closing of the lid and to provide an even surface that is uniform in appearance. Final adjustments for compaction and surface tolerance shall be done by hand.

Lids shall be stretched tight over the stone fill using only an approved lid closing tool, until the lid meets the perimeter edges of the front and end panels. Using crowbars or other single point leverage bars for lid closing shall be prohibited. Minimum overlap for lids is six inches. Lids shall be tightly tied with lacing wire, or with wire fasteners if approved by the Engineer, along all edges, ends, and internal cell diaphragms by continuous stitching with alternating single and double loops at intervals of not more than 5 inches, and a half hitch shall be included at every double loop. Special attention shall be given to see that all projections or wire ends are turned into the baskets. Where shown on the drawings or as directed by the Engineer, or where a complete gabion unit cannot be installed because of space limitations, the basket unit shall be cut, folded, and wired together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh cut out completely, or folded back and neatly wired to an adjacent gabion face. The assembling, installation, filling, lid closing, and lacing of the reshaped gabion units shall be carried out as specified above.

## **MEASUREMENT AND PAYMENT**

Gabions meeting the requirements of these specifications and acceptably placed within the limits indicated on the drawings or otherwise established in the field by the Engineer, will be measured for payment by the cubic yard of stone-filled gabions in place.

Payment will be made at the unit price bid for costs associated with gabion protection, including the costs of furnishing, assembling, and placing the wire baskets or mattresses, diaphragms, lids, steel anchors, stone fill, and all other materials, labor, equipment, tools, supplies, and all incidental costs in connection with completing this item of work.

### **ITEM 221-1 - GABIONS**

## SECTION 222 - GEOTEXTILES USED AS FILTERS

### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02378 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 123	(1993a) Standard Terminology Relating to Textiles
ASTM D 1683	(1990a) Failure in Sewn Seams of Woven Fabrics
ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 3884	(1992) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4354	(1989) Sampling of Geosynthetic for Testing
ASTM D 4355	(1992) Deterioration of Geotextile from Exposure to Ultraviolet light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1992) Water Permeability of Geotextiles By Permittivity
ASTM D 4533	(1991) Trapezoid Tearing Strength of Geotextile

ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1993) Determining the Apparent Opening Size of a Geotextile
ASTM D 4833	(1988) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(1988) Guide for Identification, Storage, and Handling of Geotextiles
ASTM D 4884	(1990) Seam Strength of Sewn Geotextiles

## SUBMITTALS

District approval is required for all submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110:

### SD-13 Certificates

Geotextile; FIO.

All brands of geotextile and all seams to be used shall be accepted on the basis of mill certificates or affidavits. The Contractor shall furnish the Engineer, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification.

### SD-14 Samples

Geotextile; FIO.

If requested by the Engineer, the Contractor shall provide to the District geotextile samples for testing to determine compliance with any or all of the requirements in this specification. When samples are to be provided, they shall be submitted a minimum of 30 days prior to the beginning of installation of the same textile. A written certificate of compliance signed by a legally authorized official from the company shall be submitted, in duplicate, upon delivery of the geotextile. The certificate shall state that the geotextile shipped to the site meets the chemical requirements and exceeds the minimum average roll value listed in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Upon

request, the contractor shall supply quality control and quality assurance tests for the geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Samples submitted for testing shall be identified by manufacturers lot designation. For needle punched geotextile, the manufacturer shall certify that the geotextile has been inspected using permanent on-line metal detectors and does not contain any needles.

## SHIPMENT, HANDLING, AND STORAGE

Only approved geotextile rolls shall be delivered to the project site. All geotextile shall be labeled, shipped, stored, and handled in accordance with ASTM D 4873. No hooks, tongs, or other sharp instruments shall be used for handling geotextile.

## MATERIALS

### GEOTEXTILE

The geotextile shall be a non-woven pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall equal or exceed the minimum average roll values listed in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Strength values indicated in the table are for the weaker principal direction.

TABLE 1  
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

Property	Requirement	Test Method
Grab Tensile Strength, lbs.	200	ASTM D 4632
Grab Elongation at Break, %	15 min., 115 max.	ASTM D 4632
Puncture Strength, lbs.	75	ASTM D 4833
Burst Strength, psi	320	ASTM D 3786
Trapezoidal Tear, lbs.	50	ASTM D 4533
Permittivity, Second <sup>-1</sup>	0.50 min.	ARIZ 730
Apparent Opening Size, U.S. Standard Sieve Size	30 -140	ASTM D 4751

Property	Requirement	Test Method
Ultraviolet Stability, %	70	ASTM D 4355

### Geotextile Fiber

Fibers used in the manufacturing of the geotextile shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

### SEAMS

The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. Seams shall be tested in accordance with method ASTM D 1683. The strength of the seam shall be not less than 90 percent of the required grab tensile strength of the unaged geotextile in any principal direction.

### SECURING PINS

The geotextile may be secured to the embankment or foundation soil by pins to prevent movement prior to placement of revetment materials. Other appropriate means to prevent movement such as staples, sand bags, and stone may also be used. Securing pins shall be inserted through both strips of overlapped geotextile along the line passing through midpoints of the overlap. Securing pins shall be removed as riprap, cushioning material or gabions are placed to prevent tearing of geotextile or enlarging holes.

The maximum pins spacing shall be 5 feet or less. On steep slopes or when windy conditions prevail at the construction site, the number of pins may be increased upon the demand of the Engineer. Terminal ends of the geotextile shall be anchored with key trench or apron at crest, toe of the slope and upstream and downstream limits of installation.

### INSPECTIONS, VERIFICATIONS, AND TESTING

## **MANUFACTURING AND SAMPLING**

Geotextiles and factory seams shall meet the requirements specified in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE.

## **SITE VERIFICATION AND TESTING**

Samples may be collected upon delivery to the site at the request of the Engineer. Samples shall be tested to verify that the geotextile meets the requirements specified in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Samples shall be identified by manufacturers name, type of geotextile, lot number, roll number, and machine direction. Testing shall be performed at an approved laboratory. Test results from the lot under review shall be submitted and approved prior to deployment of that lot of geotextile. Rolls which are sampled shall be immediately rewrapped in their protective covering.

## **EXECUTION**

### **SURFACE PREPARATION**

The surface on which the geotextile will be placed shall be prepared, to a relatively smooth surface condition, in accordance with the applicable portion of this specification and shall be free from obstruction, debris, depressions, erosion feature, or vegetation. Any irregularities will be removed so as to insure continuous, intimate contact of the geotextile with all the surface. Any loose material, soft or low density pockets of material, will be removed; erosion features such as rills, gullies etc. must be graded out of the surface before geotextile placement.

### **INSTALLATION OF THE GEOTEXTILE**

#### **GENERAL**

The geotextile shall be placed in the manner and at the locations shown. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes,

flaws, deterioration or damage incurred during manufacture, transportation or storage.

## PLACEMENT

The geotextile shall be placed with the long dimension parallel to the shoreline, channel bank, dam or spillway and laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 24 inches of overlap for each joint. Temporary pinning of the geotextile to help hold it in place until the bedding layer or riprap are placed shall be allowed. The temporary pins shall be removed as the bedding or riprap is placed to relieve high tensile stress which may occur during placement of material on the geotextile. Trimming shall be performed in such a manner that the geotextile shall not be damaged in any way.

## PROTECTION

The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of granular filter materials or riprap shall be replaced by the Contractor at no cost to the District.

The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile.

The geotextile shall be protected from damage prior to and during the placement of riprap, gabions or other materials. This may be accomplished by limiting the height of drop to less than 1 foot, by placing a cushioning layer of sand or gravel on top of the geotextile before placing the material, or other methods deemed necessary. Care shall be taken to ensure that the utilized cushioning materials do not impede the flow of water. Before placement of riprap, gabions or other materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile. In no case shall any type of heavy equipment or motorized vehicle be allowed on the unprotected geotextile.

## PLACEMENT OF CUSHIONING MATERIAL

Placing of cushioning material shall be performed in a manner to insure intimate contact of the geotextile with the prepared surface and with the cushioning

material. The placement shall also be performed in a manner that will not damage the geotextile including tear, puncture, or abrasion. On sloping surfaces the cushioning material shall be placed from the bottom of the slopes upward. During placement, the height of the drop of riprap material shall not be greater than 12 inches. Any geotextile damaged beneath the cushioning material shall be uncovered as necessary and replaced at no cost to the District.

## **OVERLAPPING**

The overlap of geotextile rolls shall be 24 inches. Appropriate measures will be taken to insure required overlap exists after cushion placement. When placing geotextile on a slope, installation shall begin at the bottom of the slope and progress upward. The uphill fabric shall overlap the downhill fabric.

## **SEWN SEAMS**

High strength thread shall be used such that seam test conforms to ASTM D 1683. The thread shall meet the chemical, ultraviolet, and physical requirements of the geotextile, and the color shall be different from that of the geotextile. The seam strength shall be equal to the strength required for the fabric in the direction across the seam. Overlapping J-type seams are preferable over prayer-type seams as the overlapping fabric reduces the chance of openings occurring at the seam. Double sewing shall be used specially for field seams to provide a safety factor against undetected missed stitches.

## **MEASUREMENT AND PAYMENT**

Installed geotextiles will be measured for payment in place by the square yard to the nearest 1 square yard of protected area as delineated in the drawings.

Payment shall be made at the contract unit price for the bid items below and shall constitute full compensation to the contractor for providing all plant, labor, material, and equipment and performing all operations necessary for the complete and satisfactory installation of the geotextile. The following items are included in the contract unit price for "geotextile" and shall not be counted a second time in the process of determining the extent of geotextile placed: Material and associated equipment and operation used in laps, seams, or extra length; securing pins and associated material, equipment, and operations; and material and associated equipment and operations used to provide cushioning layer of sand or gravel or both to permit increase in allowable drop height of stone. No payment will be

made for geotextiles replaced because of waste, contamination, damage, repair, or due to contractor fault or negligence.

## ITEM 222-1 - FILTER FABRIC

### SECTION 223 - GRAVEL MULCH

#### DESCRIPTION

The work shall consist of furnishing, placing and compacting gravel mulch on the emergency spillway and other areas as shown on the drawings.

#### MATERIALS

Rock, gravel, and sand shall conform to Section 702.4 of the MAG Uniform Standard Specifications except as modified herein.

Gravel mulch shall be free of debris, fines, and soil particles. A sample must be approved by the Engineer prior to delivery to the site.

The aggregates shall be well graded when tested in accordance with ASTM C-136 and ASTM C-117. The percentage composition by weight shall be within the following limits:

#### GRAVEL MULCH GRADATION REQUIREMENTS

Sieve Size	Percent Passing
¾ inch	100
½ inch	60-70
No. 40	5-20
No. 200	0-5

Gravel mulch color shall be approved by the Engineer prior to delivery of material to the site.

## **SUBGRADE PREPARATION**

The subgrade surfaces shall be graded to the neat lines and grades shown on the plans.

Rocks larger than 3 inches in diameter, trash, weeds, and other debris and objectionable material shall be removed or disposed of as directed by the Engineer.

Gravel mulch shall not be placed until the subgrade surfaces have been inspected and approved by the Engineer.

## **PLACEMENT**

The gravel mulch shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. The gravel mulch shall be delivered and placed in a manner that will ensure that the in-place mulch layer shall be reasonably homogeneous and the fractions uniformly distributed.

The minimum thickness of the gravel mulch layer shall be two inches.

The gravel mulch shall be hand raked and smoothed prior to water spray settling. The application of a uniform spray of water will be made at a rate not exceeding the infiltration rate to minimize runoff. The use of pressure pumps and spray bars on all sprinkling equipment used for the application of water will be required. The use of gravity flow spray bars and splash plates will not be permitted.

## **MEASUREMENT AND PAYMENT**

The exposed surface area of the gravel mulch cover will be measured within the specified pay limits and computed to the nearest square yard.

Payment for gravel mulch shall be made on the basis of the price bid per square yard, and shall be full compensation for all labor, materials, equipment, and all other items necessary and incidental to the placement of the gravel mulch. No separate payment will be made for water to settle the gravel mulch.

### **ITEM 223-1 - GRAVEL MULCH**

## **SECTION 310 - UNTREATED BASE**

Aggregate base material and construction shall conform to MAG Standard Specification 310 except as modified herein.

### **DESCRIPTION**

The work under this section shall consist of furnishing, placing and compacting aggregate base in accordance with the details shown on the project plans, the requirements of the special provisions and as directed by the Engineer.

### **MATERIALS**

Aggregate base course shall comply with Subsection 702.2 of the MAG Standard Specifications.

### **CONSTRUCTION REQUIREMENTS**

Base thickness shall be 6 inches minimum under asphalt concrete pavement. Thickness of ABC for other uses shall be as shown on the plans or specified elsewhere in the specifications.

### **MEASUREMENT AND PAYMENT**

Measurement will be by the ton delivered and placed.

Payment for untreated base will be made on the basis of the price bid per ton and includes the costs of furnishing, placing and compacting the material and all other materials, labor, equipment, tools, supplies, and all incidental costs in connection with completing this item of work. No payment will be made for material that is wasted. Costs for excavation and preparation of subgrade shall be included in this or the other items of work.

### **ITEM 310-1 - UNTREATED BASE**

## **SECTION 321 - ASPHALT CONCRETE PAVEMENT**

Asphaltic Concrete material and construction shall conform to MAG Standard Specification 321 except as modified herein.

### **DESCRIPTION**

Asphaltic concrete shall consist of furnishing all materials, mixing, hauling and placing a mixture of aggregates, mineral admixture, and bituminous material to form a pavement course or to be used for other specified purposes, in accordance with the details shown on the project plans and as directed by the Engineer.

Work under this section shall consist of re-paving portions of the parking area, park entrance road, school fire lane and Golden Eagle Blvd. or other local streets that are damaged by the contractor's activities during construction of the improvements to the dam.

Prior to mobilizing construction equipment to the site, the Contractor and the Engineer shall conduct a visual survey of the parking lot, the school fire lane and Golden Eagle Blvd. or other local streets as necessary to determine the condition of the pavement. Damaged areas shall be noted, and may be marked with paint, stakes or other methods. Photos or video may also be used to document damaged pavement. After completion of the dam and spillway construction and demobilization of the heavy equipment, the pavement shall be surveyed again to determine if the construction activities have damaged the pavement. The Engineer will make a determination of the areas and limits of pavement removal and replacement. Replacement shall be "in-kind" with a minimum requirement of 2" AC / 6" ABC.

### **SUBGRADE PREPARATION**

Subgrade preparation shall conform to MAG Standard Specification Section 301.

### **BITUMINOUS MATERIAL**

Asphalt cement shall be paving grade asphalt conforming to MAG Standard Specification Section 711, and shall be AC-40. Test reports and certifications shall be furnished in accordance with MAG Standard Specification Section 711.

## **PRESERVATIVE SEAL**

Preservative seal shall be Type A per MAG Standard Specification 718. The diluted application rate shall be 0.10 gallons per square yard minimum.

## **BITUMINOUS PRIME COAT**

Bituminous prime coat shall be per MAG Standard Specification 315. Type and grade shall be as approved by the Engineer. The diluted application rate shall be 0.10 gallons per square yard minimum.

## **JOB MIX FORMULA**

Mix shall be C  $\frac{3}{4}$  or D  $\frac{1}{2}$  as approved by the Engineer.

## **TACK COAT**

Tack coat shall meet the requirements of Section 329 of the MAG Standard Specifications. Type and grade shall be as approved by the Engineer. The diluted application rate shall be 0.10 gallons per square yard minimum.

## **EXECUTION**

The Contractor shall schedule its paving operations to minimize exposed longitudinal edges. Unless otherwise approved by the Engineer, the Contractor shall limit the placement of asphaltic concrete courses, in advance of adjacent courses, to one shift of asphaltic concrete production. The Contractor shall schedule its paving operations in such a manner to eliminate exposed longitudinal edges over weekends or holidays.

All bituminous pavement designated on the project plans or by the Engineer to be removed, shall be completely removed down to the underlying base course or subgrade. The pavement shall be removed and disposed of as specified in Section 350 - REMOVAL OF EXISTING IMPROVEMENTS of the special provisions.

Where new construction is to join existing bituminous pavement, the existing pavement shall be cut to a true line perpendicular to the centerline of the pavement with straight vertical edges free from irregularities. The removal of asphaltic

concrete at the approaches to structures shall be accomplished in a manner approved by the Engineer.

## **MEASUREMENT AND PAYMENT**

Subgrade preparation will not be measured and the cost to prepare the subgrade shall be included in the unit price for the asphalt concrete pavement.

Tack coat will not be measured and the cost to furnish and apply the tack coat shall be included in the unit price for the asphalt concrete pavement.

Prime coat will not be measured and the cost to furnish and apply the prime coat shall be included in the unit price for the asphalt concrete pavement.

Preservative seal will not be measured and the cost to furnish and apply the preservative seal shall be included in the unit price for the asphalt concrete pavement.

Asphalt concrete pavement will be measured by the ton, computed to the nearest 0.1 ton, for the mixture actually used as allowed above, including all admixtures.

Payment shall be per MAG Standard Specification Section 321.9 for the following bid items:

### **ITEM 321-1 - ASPHALT CONCRETE C-3/4**

### **ITEM 321-2 - ASPHALT CONCRETE D-1/2**

No direct payment shall be made for sand blotter or sweeping to remove sand blotter from the pavement. The cost for the required blotter shall be included in the cost of the asphalt concrete pavement.

## **SECTION 340 - CONCRETE CURB, GUTTER, SIDEWALK, DRIVEWAY AND ALLEY ENTRANCE**

The work herein shall conform to Section 340 of the MAG Uniform Standard Specifications.

Replacement of curb, gutter and sidewalk shall be "in-kind" unless shown otherwise on the plans or in the specifications. Width of sidewalk shall match the existing sidewalk.

## **MEASUREMENT AND PAYMENT**

Measurement of curbs and gutters shall be along the flow line through inlets, catch basins, etc., by the lineal foot to the nearest foot for each type, complete in place.

Concrete sidewalks shall be measured to the nearest square foot complete in place.

Payment will be made in accordance with unit prices as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment and accomplishing all work in conformance with the contract documents.

### **ITEM 340-1 - CONCRETE SIDEWALK, MAG 230 (MOD)**

### **ITEM 340-2 - CONCRETE CURB, MAG 222 TYPE B**

## **SECTION 350 - REMOVAL OF EXISTING IMPROVEMENTS**

### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02220 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Demolition shall include but not be limited to removal of the following: interfering portions of the concrete apron, wing walls and headwalls, ALERT gauge, shotcrete bank lining, riprap, chain link fence, masonry retaining walls, timber trash rack, irrigation system, existing utilities, sidewalks and curbs, and asphalt concrete pavement which is damaged during construction. Items to be removed and limits of removals are shown on the plans.

### **GENERAL REQUIREMENTS**

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from the site daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Engineer. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

## **DUST CONTROL**

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

## **PROTECTION**

### **PROTECTION OF PERSONNEL**

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

### **PROTECTION OF STRUCTURES**

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

## **PROTECTION OF EXISTING PROPERTY**

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the District; any damaged items shall be repaired or replaced as approved by the Engineer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

## **PROTECTION OF TREES**

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 6 foot high fence or other approved method. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Engineer.

## **BURNING**

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

## **USE OF EXPLOSIVES**

Use of explosives will not be permitted.

## **EXECUTION**

### **EXISTING STRUCTURES**

Existing structures indicated shall be removed as indicated on the plans or as directed by the Engineer.

## UTILITIES

Existing utilities shall be protected in place, relocated or removed as indicated on the plans. When utility lines are encountered that are not indicated on the drawings, the Engineer shall be notified prior to further work in that area.

## FILLING

Holes shall be filled in as follows.

Outside of the dam embankment, abutment and spillway areas:

1. Holes shall be filled with native material or topsoil and compacted to minimum of 85% relative compaction. Compaction testing will not be required.
2. Holes under pavement or structures shall be backfilled with granular material or Aggregate Base Course and compacted to 95% relative compaction. Compaction testing will be required.

Within the dam embankment and spillway:

1. Holes within the dam embankment area shall be filled in with an approved, well graded impervious backfill material obtained from the spillway excavation or other approved source. The material shall be consistent with surrounding embankment fill. Method of surface preparation, materials for backfill and compaction requirements are specified in Section 203 - EARTHWORK and Section 205 - EMBANKMENT FOR EARTH DAMS and shall be approved by Arizona Department of Water Resources (ADWR) and the Engineer.

## DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, is vested in the Contractor upon receipt of notice to proceed. The District will not be responsible for the condition, loss or damage to such property after notice to proceed.

## SALVAGEABLE ITEMS AND MATERIAL

Contractor shall salvage items and material to the maximum extent possible.

## Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Engineer and shall be removed from the site before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

## Items Salvaged for the District

Salvaged items to remain the property of the District shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

## UNRECOVERABLE MATERIAL

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in a sanitary landfill or recycled.

## CLEAN UP

Debris and rubbish shall be removed from excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

## PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and as specified in Section 321 - ASPHALT CONCRETE PAVEMENT and to the limits and depths indicated on the drawings or as directed by the Engineer.

## ALERT GAUGE

The ALERT rain and flow depth gauge is located on top of the dam embankment near the principal outlet works. It will be removed and salvaged by the District.

## **MEASUREMENT AND PAYMENT**

Removal of masonry retaining walls will be measured for payment by the lineal foot to the nearest 1 foot of wall removed as delineated on the drawings or as directed by the Engineer in the field. Payment will be made at the contract unit price and this price shall constitute full compensation for all labor, equipment, tools, disposal fees and incidentals necessary to remove and dispose of the walls as specified herein.

### **ITEM 350-1 - REMOVE EXISTING RETAINING WALLS**

Payment will be made at the contract lump sum for removal of the trash rack and this price shall constitute full compensation for all labor, equipment, tools, disposal fees and incidentals necessary to remove and dispose of the rack.

### **ITEM 350-2 - REMOVE EXISTING TRASH RACK**

Sawcutting and removal of asphalt concrete pavement will be measured for payment by the square yard to the nearest 1 square yard of pavement removed as delineated on the drawings or as directed by the Engineer in the field. Payment will be made at the contract unit price and this price shall constitute full compensation for all labor, equipment, tools, disposal fees and incidentals necessary to remove and dispose of the pavement as specified herein.

### **ITEM 350-3 - SAWCUT AND REMOVE ASPHALT CONCRETE PAVEMENT**

Cutting and removal of portland cement concrete sidewalk will be measured for payment by the lineal foot to the nearest 1 foot of sidewalk removed as delineated on the drawings or as directed by the Engineer in the field. Payment will be made at the contract unit price and this price shall constitute full compensation for all labor, equipment, tools, and incidentals necessary to remove and dispose of the sidewalk, and fill any remaining holes as specified herein.

### **ITEM 350-4 - CUT AND REMOVE CONCRETE SIDEWALK**

Cutting and removal of portland cement concrete curb and concrete spillway cutoff wall will be measured for payment by the lineal foot to the nearest 1 foot of curb or

cutoff wall removed as delineated on the drawings or as directed by the Engineer in the field. Payment will be made at the contract unit price and this price shall constitute full compensation for all labor, equipment, tools, disposal fees and incidentals necessary to cut and remove and dispose of the concrete, and fill any remaining holes as specified herein.

**ITEM 350-5 - CUT AND REMOVE CONCRETE CURB**

**ITEM 350-6 - CUT AND REMOVE CONCRETE CUTOFF  
WALL**

Cutting and removal of shotcrete slope protection will be measured for payment by the square yard to the nearest 1 square yard of shotcrete removed as delineated on the drawings or as directed by the Engineer in the field. Payment will be made at the contract unit price and this price shall constitute full compensation for all labor, equipment, tools, disposal fees and incidentals necessary to cut and remove and dispose of the shotcrete as specified herein.

**ITEM 350-7 - CUT AND REMOVE SHOTCRETE**

Cutting and removal of chain link fence will be measured for payment by the lineal foot to the nearest 1 foot of fence removed as delineated on the drawings or as directed by the Engineer in the field. Payment will be made at the contract unit price and this price shall constitute full compensation for all labor, equipment, tools, disposal fees and incidentals necessary to remove and dispose of the fence, and fill any remaining post holes as specified herein.

**ITEM 350-8 - CUT AND REMOVE FENCE**

Removal and salvage of riprap will be measured for payment by the cubic yard to the nearest cubic yard of riprap removed as delineated on the drawings or as directed by the Engineer in the field. Payment will be made at the contract unit price and this price shall constitute full compensation for all labor, equipment, tools, disposal fees and incidentals necessary to remove and salvage the riprap as directed by the District.

**ITEM 350-9 - REMOVE AND SALVAGE RIPRAP**

No separate payment will be made for removals not included in the bid items above and the cost of these miscellaneous removals shall be included in the cost of the appurtenant work.

## SECTION 420 – CHAIN LINK FENCES

### GENERAL

Work under this section shall conform to MAG Standard Specification 420 except as modified herein.

The work shall consist of furnishing and installing chain link fencing and gates as shown on the plans.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 116	(1995) Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 153/A 153M	(1995) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 176	(1996) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 478	(1995a) Chromium-Nickel Stainless and Heat-Resisting Steel Weaving and Knitting Wire
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric

ASTM A 666	(1996b) Austenitic Stainless Steel Sheet; Annealed or Cold-Worked
ASTM A 702	(1989; R 1994) Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM D 4541	(1995) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM F 626	(1996) Fence Fittings
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1995) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

## **SUBMITTALS**

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110:

SD-13 Certificates

Chain Link Fence; DA

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

## **ACCESSORIES**

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

## **INSTALLATION**

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the minimum extent required. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

## **EXCAVATION**

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 2 inch clearance between the bottom of the fabric and finish grade.

## **POST INSTALLATION**

Posts shall be set plumb and in alignment. Except where solid rock is encountered, line posts shall be set in concrete to a depth of 30 inches and corner, end, intermediate, gate, latch and pull posts to a depth of 36 inches. Posts shall extend to within 6 inches of the bottom of the post hole. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than 10 inch in diameter. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be

thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts.

## **TOP RAIL**

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail.

## **TENSION WIRES**

Tension wires shall be installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 1 foot of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

## **CHAIN LINK FABRIC**

Chain link fabric shall be installed on the high side of the post or as directed by the Engineer. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 12 inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 plus or minus ½ inch above the ground.

## **GATE INSTALLATION**

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

## **MEASUREMENT AND PAYMENT**

Fence meeting the requirements of these specifications and acceptably installed as indicated on the drawings or otherwise established in the field by the Engineer, will be measured by the linear foot, deducting the widths of gates and openings.

Payment for fence will be made at the unit price bid for costs associated with fencing, including the costs of furnishing, assembling and installing the fence posts, fabric, bracing, tension wires, top rail, and all appurtenant items, and all other materials, labor, equipment, tools, supplies, and all incidental costs in connection with completing this item of work.

### **ITEM 420-1 - 6' CHAIN LINK FENCE**

### **ITEM 420-2 - 8' CHAIN LINK FENCE**

Gates meeting the requirements of these specifications and acceptably installed as indicated on the drawings or otherwise established in the field by the Engineer, will be measured by each gate of the size and type specified.

Payment for gates will be made at the unit price bid for costs associated with installing the gate complete in place including; the costs of furnishing, assembling and installing the gate posts, fabric, bracing, tension wires, rails, latches, stops and keepers, hinges and hinge pins and all other appurtenant items; and all other materials, labor, equipment, tools, supplies, and all incidental costs in connection with completing this item of work.

### **ITEM 420-3 - 6' CHAIN LINK X 4' SINGLE LEAF GATE**

### **ITEM 420-4 - 6' CHAIN LINK X 12' DOUBLE LEAF GATE**

## **SECTION 425 - TOPSOIL**

### **Description:**

The work under this section shall consist of furnishing, hauling and placing topsoil in accordance with the details shown on the project plans and the requirements of these specifications.

**Materials:**

Topsoil shall be obtained from the required excavations. It shall be stockpiled and protected from contamination.

Topsoil shall be fertile, friable soil obtained from well drained arable land which has or is producing healthy crops, grasses or other vegetation. It shall be free draining, non-toxic and capable of sustaining healthy plant growth.

Topsoil shall be reasonably free of subsoil, refuse, roots, heavy clay, clods, coarse sand, large rocks, sticks, brush, litter and other deleterious substances.

**Construction Requirements:**

Topsoil shall be spread uniformly on the designated areas to the depths or contours shown on the plans. The contractor shall avoid overcompaction in spreading and shaping operations. Scarification shall be required for over-compacted areas and haul roads. When topsoil is placed over subgrade material as plating, the subgrade shall be scarified or disced to a six-inch depth prior to placement of the topsoil.

**MEASUREMENT AND PAYMENT**

No measurement shall be made.

Payment for placement of topsoil as specified on the plans and in the specifications shall be made at the contract lump sum price and this price shall constitute full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work specified herein.

**ITEM 425-1 - TOPSOIL**

**SECTION 430 - LANDSCAPING AND PLANTING**

**General**

The work herein shall conform to MAG Standard Specification Section 430 except as modified.

## Description

Seeding shall consist of furnishing and applying chemical fertilizer; furnishing and planting grass and wildflower seed and furnishing, applying and affixing mulch. The areas to be seeded are disturbed or unvegetated areas as shown on the plans and designated by the Engineer.

## Tree, Shrub, And Ground Cover Planting

The species, sizes, the manner in which to be furnished, and the approximate number are as shown in the plant list. The quantities, as listed, are approximate and the Contractor shall furnish and install all plant material necessary to complete the plantings as shown on the mitigation plan. Change order adjustment will be made for unit price proposals, but not for lump sum proposals.

## Landscaping Areas

Miscellaneous areas that are cleared or disturbed including, but not limited to the following shall be prepared with topsoil and re-seeded with the Type 1 seed mix:

- ◆ Area at the right end of emergency spillway
- ◆ Top of dam, upstream and downstream face
- ◆ Staging area
- ◆ Access and haul routes (except where they lie within the wash)
- ◆ Other disturbed areas as designated by the Engineer, Town or School

The mitigation area which is in the wash up and downstream of the principal and auxiliary outlet works and along the toe of the dam on the upstream side shall be fine graded, prepared with topsoil and re-seeded with Type 2 seed mix. Pole and nursery stock shall also be planted to replace those larger plants removed by the clearing and grubbing and excavation within the wash.

## Materials

### Seed

Type 1 seed shall consist of the following species:

Agropyron dasystachyum (Thickspike wheatgrass)  
Koeleria cristata (Prairie junegrass)  
Bouteloua gracilis (Bluegramma)  
Mullenbergia wrightii (Spike muhly)  
Sporobolus cryptandrus (Sand dropseed)  
Sphaeralcea ambigua (Desert globemallow)  
Stipa comata (Needle & thread)

Type 2 seed shall consist of the following species:

Blue Palo Verde	<i>Cercidium floridum</i>
Brittle Bush	<i>Encelia farinosa</i>
Desert Cassia	<i>Cassia covesii</i>
Globe Mallow	<i>Sphaeralcea ambigua</i>
Indian Wheat	<i>Plantago insluariss</i>
Purple Three-Awn	<i>Artistida purpurea</i>
Sweetbush	<i>Bebbia juncea</i>
Sand Dropseed	<i>Sporobolus cryptandrus</i>
Triangle Bursage	<i>Ambrosia deltoidea</i>

The following pole/nursery stock are required:

Blue Paloverde	<i>Ceridium floridum</i>
Freemont Cottonwood	<i>Populus fremontii</i>
Goodding Willow	<i>Salix gooddingii</i>

Within 30 days after the award of contract the Contractor shall submit the name of the landscaping subcontractor he will use and written confirmation that the source for the seed and plants specified herein has been secured. The Contractor shall notify the Engineer if any of the seed or plants specified is currently unavailable and the prospects of its availability throughout the duration of the contract. Any requested changes in seed or plant varieties due to unavailability shall be submitted to the Engineer at this time.

A certificate of analysis from an accredited Seed testing lab shall accompany each container of seed. Seed shall be delivered to the site in individual seed containers by species.

Application rates of seed as specified are for Pure Live Seed (PLS). PLS is determined by multiplying the sum of the germination and hard or dormant seed by the purity.

Weed content of seed shall not exceed 0.5 percent and shall conform to the requirements of Subsection 805-2.02 of the ADOT Standard Specifications.

## Substitutions

Substitutions will not be allowed for the nursery stock trees or for the Type 2 seed mix.

Substitution of larger size of the same specie may be made by the Contractor without written approval. However, the Contracting Agency will not be responsible for any additional costs incurred by the Contractor, either for the additional cost of the plants or for any additional planting costs.

## Tackifier

Tackifier shall be a naturally occurring organic compound and be non toxic. It shall be a product typically used for binding soil and mulch in seeding or erosion control operations. Approved types shall consist of the mucilage or gum obtained from guar or plantago. The tackifier shall be labeled indicating the type and mucilage purity. Application rates for tackifier shall be on a pure mucilage per acre basis for the following applications.

## Emulsified Asphalt

Emulsified asphalt shall be type SS-1 or CSS-1 and shall conform to the requirements of MAG Standard Specifications Section 713.

## Hydroseeding

Use in hydromulch slurry with seed, wood fiber and water.

Slope	Tackifier amount - pure mucilage per acre
flat to 4:1	40 pounds
4:1 to 3:1	60 pounds
3:1 to 2:1	80 pounds
2:1 +	100 pounds

## Straw Mulching

Use in affixing straw mulch. Apply with a slurry of wood fiber mulch and water over straw.

Area	Tackifier amount - pure mucilage per acre
All Areas	125 pounds

Wood Cellulose Fibers

Wood fiber mulch shall be from thermo-mechanically processed wood, processed to contain no growth germination inhibiting factors. The mulch shall be from minimum 90% virgin wood and be manufactured and processed so the fibers will remain in uniform suspension in water under agitation to form a homogenous slurry.

Fertilizer

Chemical fertilizer shall conform to the requirements of Subsection 805-2.06 of the ADOT Standard Specifications and shall be the kind as hereafter specified. The sulfur coated urea specified herein shall have 80% of the nitrogen defined as slow release, and contain 5% Iron, 10% Sulfur and trace amounts of Zinc and Manganese shall also be included.

Straw Mulch

Straw mulch shall conform to the requirements of Subsection 805-2.03 of the ADOT Standard Specifications and shall be from the current season's crop. Straw originating out of Arizona shall have a letter of certification from that state certifying that the field of origin has been inspected and is free of noxious weeds. No rye straw will be acceptable.

**Trees and Shrubs**

Construction Requirements

General

Seeding shall be accomplished as soon as possible after the slopes and those portions of the project area that have been disturbed have been finished. This requirement may require frequent mobilizations during the grading operations. The Contractor should coordinate the seeding operations with the grading operations to

determine mobilization frequency as embankment and cut slopes are finished throughout the duration of the project.

### Plant Location

The Engineer will stake out the location of planting areas and planting pits for nursery stock and Type 2 seeding. Subject to the Engineer's approval, minor relocation may be accomplished at this time to avoid unsuitable conditions, such as utilities, rocky areas, poor soil, etc. If major relocations are necessary, the Engineer will restake.

### Tillage

All slopes flatter than 3:1 shall be tilled a minimum of 4" in depth as they are constructed.

All areas to be seeded shall have the following chemical fertilizers uniformly applied to the surface at the rate specified. All slopes 3:1 and flatter shall have the fertilizer tilled into a minimum of the top four inches of the surface. Fertilizer shall be sulfur coated urea (25-4-8) applied at a rate of 200 lbs. per acre.

Tillage shall be accomplished with a ripper bar, chisel plow or harrow tool or with other equipment which will provide thorough soil cultivation and an even mixture of fertilizer into the soil.

Tillage shall be performed along the contour. No work shall be done when the moisture content of the soil is unfavorable or the ground is otherwise in a condition inimical to tillage.

All competitive vegetation shall be uprooted during the tillage operation and the soil shall be left in a roughened condition free of clods or large stones over six inches in any dimension and other foreign material that would interfere with the seeding operation.

### Planting

After the tillage is completed and accepted by the Engineer, seed shall be broadcast and covered by hand raking or other approved methods. Hydroseeding is an acceptable alternate method for seed distribution provided tackifier applied at the rate shown in the chart under Materials and 200 pounds per acre of wood fiber are included in the slurry with the seed. Seed shall not be in the slurry more than 30 minutes. Seed planted by this method will not require covering with soil. The Contractor shall submit a batch (tank) mix of the Engineers' approval prior to mixing any seed/mulch slurry. Batch mixing and coverage will be monitored throughout



Mulch shall be immediately affixed by crimping and tacking. The Engineer shall determine which areas are not conducive to anchoring by crimping and will direct the Contractor to anchor such mulch by tacking only.

Within 24 hours after each area is planted, straw mulch shall be uniformly applied at the rate of approximately 2½ tons per acre for crimped and tacked areas and 1¾ tons per acre for tacked only areas.

#### Anchorage by Crimping

Mulch shall be anchored into the soil with a heavy disc with flat, serrated discs at least ¼ inch thick having dull edges and spaced no more than nine inches apart. Mulch shall be anchored to a depth of at least two inches and shall not be covered with an excessive amount of soil. Anchoring operations shall be across the slopes where practical with no more than two passes of the anchoring equipment. Immediately following the crimping operation the crimped area shall be tacked as specified under Anchorage by Tacking.

#### Anchorage by Tacking

Mulch shall be anchored by tacking using either emulsified asphalt uniformly applied at the rate of approximately 500 gallons per acre or a slurry consisting of a minimum of 125 pounds of tackifier, 400 pounds of wood fiber mulch and 700 gallons of water per acre.

#### Tree Pits

Planting pits shall be approximately circular with a diameter and depth at least twice the size of the plant ball or container. It must be large enough to permit handling and planting without injury or breakage of the root ball or root system. The excavated soil will be conditioned and used as prepared soil mix for backfill. Plants will not be allowed to stand in these pits without watering.

Prepared soil mix shall consist of one part organic soil conditioner per MAG Uniform Standard Specifications Section 795, two parts excavated soil and one pound of gypsum and four ounces of soil sulfur per tree. The Contractor shall notify the Engineer prior to mixing prepared soil so that he may observe the mixing process. In addition, during backfilling, slow release fertilizer tables, Agriform 21 gram tablets with a 20-10-5 analysis or approved equal, shall be added in the following quantities:

For one-gallon container ..... 1 tablet

For five-gallon container ..... 2 tablets  
For fifteen-gallon container ..... 4 tablets  
For twenty-four inch or larger box ..... 6 tablets

All containers shall be opened and removed in such a manner that the roots of the plant are not damaged. Balled plants wrapping shall be loosened or cut back after the plant is positioned in the pit.

A layer of prepared soil mix shall be placed in the pit and the plant shall be set approximately in the center of the hole with the root crown at its natural growing depth with respect to finish grade. The plant shall be faced so as to present the best appearance and relationship to adjacent plants or structures. It shall be rigidly constrained until backfilling with prepared soil mix and slow release fertilizer tablets is completed. The backfill will be thoroughly settled by tamping and watering so that all voids are filled.

Trees shall be supported by a minimum of three tree stakes per MAG Uniform Standard Specifications Section 795 with a top tie placed for maximum support and second tie placed midway between top tie and ground level.

After planting, the plants shall be pruned as directed by the Engineer.

#### Plant Guarantee And Maintenance

The Contractor shall insure that all plant materials are in a sound, healthy, vigorous condition free from insects, bark abrasions, or other objectionable disfigurements and shall immediately replace any plant which is unacceptable at any time up to and including final acceptance of the project or completion of the plant establishment period whichever occurs later. When the termination of the plant establishment period extends beyond the final acceptance date for the project, this additional period of time for plant establishment may be considered as a special warranty period within the standard 1-year guarantee period and the Engineer may authorize final payment in accordance with Section 109 of the MAG Uniform Standard Specifications. Unless otherwise authorized by the Engineer, the Contractor shall maintain all landscaped areas on a continuous basis as they are completed during the course of work and until final project acceptance or the termination of the plant establishment period, whichever occurs later. Maintenance shall include keeping the landscape areas free of debris and weeding and cultivating the planted areas at interval acceptable to the Engineer. ~~Do we need to add irrigation? - ask Bob~~ The Contractor shall provide adequate personnel to accomplish the required maintenance. Pruning and restaking of plants shall be directed by the Engineer.

#### Plant Establishment Period

The Contractor shall request an inspection by the Engineer whenever substantial completion of the planting and related work has been accomplished. After this initial inspection, and subject to his approval of the work, the Engineer will issue a written field notification to the Contractor setting the effective, beginning date for plant establishment. The plant establishment period shall be for a period of 60 calendar days (check with Bob - is this OK), but is subject to extension by the Engineer if the landscape areas are improperly maintained, appreciable plant replacement is required, or other corrective work becomes necessary.

At final project acceptance or at the end of the plant establishment period, a final acceptance inspection of the planted areas will be made by the Engineer.

#### Measurement and Payment

Measurement of seeding shall be by the acre to the nearest 0.01 acre for the type of seeding specified. Measurement of nursery stock shall be by the number of trees planted per size and species. Measurement for removal and replacement of turf lawn shall be by the square yard to the nearest square yard.

Payment shall be at the unit prices bid for seeding, planting of nursery stock and removal and replacement of lawn and shall be full compensation for furnishing all labor, material, tools and equipment and for performing all work necessary to complete the landscaping operation. Are 5 gallon trees acceptable for the mitigation plan area?

**ITEM 430-1 - TYPE 1 SEEDING**

**ITEM 430-2 - TYPE 2 SEEDING**

**ITEM 430-3 - REMOVE AND REPLACE TURF LAWN**

**ITEM 430-4 - BLUE PALOVERDE, 5 GAL.**

**ITEM 430-5 - FREEMONT COTTONWOOD, 5 GAL.**

**ITEM 430-6 - GOODDING WILLOW, 5 GAL.**

At least 75 percent of the applied tackifier and straw mulch shall remain in place for a minimum period of 30 days after application. Any areas that have less than 75

percent of the tackifier or straw mulch remaining, after any application, shall be reseeded, remulched, and retacked at no additional cost to the District.

## **SECTION 440 - SPRINKLER IRRIGATION SYSTEM INSTALLATION**

Sprinkler irrigation system installation shall conform to MAG Standard Specification 440 except as modified herein.

### **DESCRIPTION**

The work under this section shall consist of removing and replacing the turf irrigation system upstream of the emergency spillway. It shall also include any modifications to the system required due to the change in elevation of the turfed area. Additional irrigation lines exist along the alternate access road and around the ball fields. If these systems are damaged during construction, they shall be repaired or reconstructed per this specification, and at no additional cost to the District.

**Do we need an irrigation system for the mitigation plan plants?**

### **MEASUREMENT AND PAYMENT**

No measurement shall be made. Payment will be made at the contract lump sum price for the bid items listed below, for all labor, materials, equipment, tools, and incidentals necessary to complete the work specified herein.

#### **ITEM 440-1 - REMOVE & REPLACE TURF IRRIGATION SYSTEM**

## **SECTION 504 - STRUCTURAL CONCRETE FORMWORK**

### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-03100 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### ACI INTERNATIONAL (ACI)

ACI 347R (1994) Guide to Formwork for Concrete

### AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA ANSI/AHA A135.4 (1995) Basic Hardboard

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal Insulation

### DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1996) Voluntary Product Standard - Construction and Industrial Plywood

## DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 505 CONCRETE STRUCTURES. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

## PRODUCTS

## **FORM MATERIALS**

### **FORMS FOR CLASS A AND CLASS B FINISH**

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels.

### **FORMS FOR CLASS C FINISH**

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA ANSI/AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used.

### **FORMS FOR CLASS D FINISH**

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

### **FORM TIES**

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

### **FORM RELEASING AGENTS**

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent

treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

## **EXECUTION**

## **INSTALLATION**

## **FORMWORK**

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 505 CONCRETE STRUCTURES and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

## **CHAMFERING**

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

## **COATING**

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

## REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

### TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 10 feet of length	1/4 inch
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length	1 inch
b. For exposed corner columns, control-joint	In any 20 feet of length	1/4 inch
	grooves, and other conspicuous lines Maximum for entire length	1/2 inch
2. Variation from the level or from the grades indicated on the drawings:	In an 10 feet of length	1/4 inch
	In any bay or in any 20 feet of length	3/8 inch

a. In slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length	3/4 inch
b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length	1/4 inch
	Maximum for entire length	1/2 inch
3. Variation of the linear structure lines from established position in plan	In any 20 feet	1/2 inch
	Maximum	1 inch
4. Variation of distance between walls, columns, partitions	per 10 feet of distance	1/4 inch
	but not more than	1/2 inch in any one bay
	and not more than	1 inch total variation
5. Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus	1/4 inch
	Plus	1/2 inch
6. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus	1/4 inch
	Plus	1/2 inch

7. Footings:

- |                                    |  |  |
|------------------------------------|--|--|
| a. Variation of dimensions in plan | when formed,                               | Minus 1/2 inch   |
|                                    | or when placed against unformed excavation | Plus 2 inches plus 3 inches  |
| b. Misplacement of eccentricity    |  | 2 percent of the footing width in the direction of misplacement but not more than 2 inches |
| c. Reduction in thickness          |  | Minus 5 percent of specified thickness   |

**MEASUREMENT AND PAYMENT**

Furnishing and installing and removing forms shall be considered incidental to the construction of the concrete structures and no separate payment will be made for formwork.

**SECTION 505 - CONCRETE STRUCTURES**

**GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-03301 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Work under this section shall consist of constructing the spillway cutoff wall, spillway floodwall, headwalls, wingwalls and aprons, auxiliary outlet works box culvert, energy dissipater and other miscellaneous concrete structures.

Headwalls, wingwalls, aprons, floodwall and energy dissipater shall be constructed and concrete shall reach a compressive strength of at least 70% of the specified

28-day design compressive strength prior to excavation or backfill adjacent to the structures.

The auxiliary outlet works box culvert shall be pre-cast and cured for 28 days or until it reaches its design strength prior to installation. It shall be installed on a green concrete foundation slab. The foundation slab shall be poured and the box culvert set in place within 4 hours so that a good bond will form between the foundation slab and the pre-cast box structure.

During dam stripping, benching, embankment fill and backfill construction, both the existing and new headwalls and wingwalls shall be monitored for movement by setting survey benchmarks and monitoring on a daily basis. Any movement of any concrete structure during earthwork operations shall be reported to the Engineer immediately.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### ACI INTERNATIONAL (ACI)

- |                |   |
|----------------|---|
| ACI 117/117R   | (1990; Errata) Standard Tolerances for Concrete Construction and Materials                    |
| ACI 211.1      | (1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete |
| ACI 214        | (1977; R 1989) Evaluation of Strength Test Results of Concrete                                |
| ACI 303R       | (1991) Cast-in-Place Architectural Concrete Practice  |
| ACI 305R       | (1991) Hot Weather Concreting   |
| ACI 306R       | Cold Weather Concreting   |
| ACI 318/318R   | (1992; Rev 1992; Errata) Building Code Requirements for Reinforced Concrete                   |
| ACI 318M/318RM | (1992) Building Code Requirements for Reinforced Concrete (Metric)                            |

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1994) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	(1992) Organic Impurities in Fine Aggregates for Concrete
ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beam of Concrete
ASTM C 87	(1983; R 1990) Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 123	(1994) Lightweight Pieces in Aggregate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1978; R 1990) Clay Lumps and Friable Particles in Aggregates
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete

ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 192	(1990a) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1994) Air-Entraining Admixtures for Concrete
ASTM C 289	Standard Specification for Potential Reactivity of Aggregates
ASTM C 295	(1990) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(1994) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 441	(1989) Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 535	(1989) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 566	(1989) Total Moisture Content of Aggregate by Drying
ASTM C 595	(1994a) Blended Hydraulic Cement
ASTM C 597	(1983; R 1991) Pulse Velocity Through Concrete
ASTM C 618	(1994a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 666	(1992) Resistance of Concrete to Rapid Freezing and Thawing

ASTM C 803	(1990) Penetration Resistance of Hardened Concrete
ASTM C 805	(1994) Rebound Number of Hardened Concrete
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 989	(1994a) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1991) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064	(1986; R 1993) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1995a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1991a) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 75	(1987; R 1992) Sampling Aggregates

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1994) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices
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NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1990) Concrete Plant Standards
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**SUBMITTALS**

District approval is required for all submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110.

SD-01 Data

#### Concrete Mixture Proportioning; FIO.

Concrete mixture proportions shall be determined by the Contractor, in accordance with the requirements in paragraph CONCRETE MIXTURE PROPORTIONING, and submitted for review. The concrete mixture quantities of all ingredients per cubic yard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate the mass of cement, pozzolan and ground granulated blast-furnace (GGBF) slag when used, and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

#### Batch Plant; FIO.

The Contractor shall submit batch plant data to the Engineer for review for conformance with applicable specifications.

#### Concrete Mixers; FIO.

The Contractor shall submit concrete mixer data which includes the make, type, and capacity of concrete mixers proposed for mixing concrete in conformance with the paragraphs CAPACITY and CONCRETE MIXERS.

#### Conveying Equipment and Methods; FIO.

The conveying equipment and methods for transporting, handling, and depositing the concrete shall be submitted for review by the Engineer for conformance with paragraphs CAPACITY and CONVEYING EQUIPMENT.

#### Placing Equipment and Methods; FIO.

All placing equipment and methods shall be submitted for review by the Engineer for conformance with paragraph CAPACITY.

#### SD-08 Statements

#### Construction Joint Treatment; DA.

The method and equipment proposed for joint cleanup and waste disposal shall be submitted for review and approval for conformance with paragraph CONSTRUCTION JOINT TREATMENT.

Curing and Protection; DA.

The curing medium and methods to be used shall be submitted for review and approval for conformance with paragraph CURING AND PROTECTION.

Cold-Weather Placing; DA.

If concrete is to be placed under cold-weather conditions, the proposed materials, methods, and protection meeting the requirements of paragraph COLD-WEATHER PLACING shall be submitted for approval.

Hot-Weather Placing; DA.

If concrete is to be placed under hot-weather conditions, the proposed materials and methods, meeting the requirements of paragraph HOT-WEATHER PLACING and paragraph FINISHING, shall be submitted for review and approval.

#### SD-09 Reports

Aggregate Quality; DA.

Aggregate quality tests shall be submitted at least 30 days prior to start of concrete placement, in accordance with paragraph QUALITY OF AGGREGATES.

Uniformity of Concrete Mixing; FIO.

The results of the initial mixer uniformity tests as required in paragraph MIXER UNIFORMITY shall be submitted at least 5 days prior to the initiation of placing.

Tests and Inspections; FIO.

Test results and inspection reports shall be submitted daily and weekly as required in paragraph REPORTS.

#### SD-13 Certificates

Cementitious Materials; FIO.

Cementitious Materials, including Cement and Pozzolan, and Ground Granulated Blast-Furnace Slag will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished. Certification and mill test reports shall be from samples taken from the particular lot furnished. No cementitious materials shall be used until notice of acceptance has been given by the Engineer. Cementitious materials will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the

Engineer, and such sampling will be by or under the supervision of the District at its expense. Material not meeting specifications shall be promptly removed from the site of work.

Air-Entraining Admixture; FIO.

Air-Entraining Admixture shall be certified for compliance with all specification requirements.

Other Chemical Admixtures; FIO.

Other Chemical Admixtures shall be certified for compliance with all specification requirements.

Membrane-Forming Curing Compound; FIO.

Membrane-Forming Curing Compound shall be certified for compliance with all specification requirements.

Epoxy Resin; FIO. Latex Bonding Compound; FIO.

Epoxy Resin and Latex Bonding Compound shall be certified for compliance with all specification requirements.

Nonshrink Grout; FIO.

Descriptive literature of the Nonshrink Grout proposed for use shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered.

#### SD-14 Samples

Aggregates; DA. Cementitious Materials, Admixtures, and Curing Compound; DA.

Samples of materials for District testing and approval shall be submitted as required in paragraph PRECONSTRUCTION SAMPLING AND TESTING.

### **DISTRICT TESTING AND SAMPLING**

The District will sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172.

## PRECONSTRUCTION SAMPLING AND TESTING

### Aggregates

The Contractor must furnish materials from a commercial source. Samples from any source of coarse aggregate and any source of fine aggregate selected by the Contractor, consisting of not less than 150 pounds of each size coarse aggregate and 75 pounds of fine aggregate taken under the supervision of the Engineer shall be delivered to the Contract Administrator within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. Testing will be performed by and at the expense of the District in accordance with the applicable COE CRD-C or ASTM test methods. The cost of testing one source for each size of aggregate will be borne by the District. If the Contractor selects more than one source for each aggregate size or selects a substitute source for any size aggregate after the original source was tested, the cost of that additional testing will be borne by the Contractor. Tests to which aggregate may be subjected are listed in paragraph QUALITY. The material from the proposed source shall meet the quality requirements of this paragraph.

### Cementitious Materials, Admixtures, and Curing Compound

Within 15 days after notice to proceed, the Contractor shall notify the Engineer of the sources for cementitious materials, admixtures, and curing compound, along with sampling location, brand name, type, and quantity to be used in the manufacture and/or curing of the concrete.

### CONSTRUCTION TESTING BY THE DISTRICT

Sampling and testing will be performed by and at the expense of the District except as otherwise specified. No material shall be used until notice has been given by the Engineer that test results are satisfactory.

### Chemical Admixtures Storage

Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the Contractor when directed by the Engineer and shall be rejected if test results are not satisfactory. Chemical admixtures will be accepted based on compliance with the requirements of paragraph CHEMICAL ADMIXTURES.

## Cement and Pozzolan

If cement or pozzolan is to be obtained from more than one source, the initial notification shall state the estimated amount to be obtained from each source and the proposed schedule of shipments.

## Concrete Strength

Compressive strength test specimens will be made by the District and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength  $f'_c$  and no individual test result falls below the specified strength  $f'_c$  by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including nondestructive testing, taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

a. Investigation of Low-Strength Test Results - When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803, or ASTM C 805 may be permitted by the Engineer to estimate the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.

b. Testing of Cores - When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Engineer to least impair the performance of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement.

c. Load Tests - If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may

be directed by the Engineer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test shall be corrected in a manner satisfactory to the Contacting Officer. All investigations, testing, load tests, and correction of deficiencies will be performed and approved by the Engineer at the expense of the Contractor, except that if all concrete is in compliance with the plans and specifications, the cost of investigations, testing, and load tests will be at the expense of the District.

## TESTS AND INSPECTIONS

Tests and inspections shall conform to the requirements specified in the Construction Quality Assurance section of the special provisions.

## GENERAL

The District shall perform the inspections and tests described below. When, in the opinion of the Engineer, the concreting operation is out of control, concrete placement shall cease. The laboratory performing the tests shall conform with ASTM C 1077. The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete construction shall have demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Construction Inspector, Level II. The District will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077.

## TESTING AND INSPECTION REQUIREMENTS

### Fine Aggregate

a. Grading - At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 for the fine aggregate or for each size range of fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits.

b. Corrective Action for Fine Aggregate Grading - When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Engineer. The concrete supplier shall inform the Engineer immediately of the steps taken to correct the gradation and a third sample will be taken. If this sieve analysis is outside the specification limits, the operation shall be considered out of control and concreting shall be stopped until the correct grading has been obtained.

c. Moisture Content Testing - When in the opinion of the Engineer the electric moisture meter is not operating satisfactorily, there shall be at least four tests for moisture content in accordance with ASTM C 566 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content shall be used to adjust the added water in the control of the batch plant.

d. Moisture Content Corrective Action - Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device) if necessary to maintain the specified slump.

#### Coarse Aggregate

a. Grading - At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control which are coarser than the specification limits for samples taken at locations other than as delivered to the mixer to allow for degradation during handling.

b. Corrective Action for Grading - When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Engineer. Where two consecutive averages of five

tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Engineer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

c. Coarse Aggregate Moisture Content - A test for moisture content of each size group of coarse aggregate shall be made at least twice per week. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified above for fine aggregate, until the difference falls below 1.0 percent.

d. Coarse Aggregate Moisture Corrective Action - Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted if necessary to maintain the specified slump.

#### Quality of Aggregates

a. Frequency of Quality Tests - Thirty days prior to the start of concrete placement the tests shall be performed for aggregate quality listed below. In addition, after the start of concrete placement, the tests shall be performed for aggregate quality in accordance with the frequency schedule shown below. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

PROPERTY	FREQUENCY		TEST
	FINE AGGREGATE	COARSE AGGREGATE	
Specific Gravity	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Absorption	Every 3 months	Every 3 months	ASTM C 127
Durability Factor Using, (Procedure A)	Every 12 months	Every 12 months	ASTM C 666
Clay Lumps and Friable Particles	Every 3 months	Every 3 months	ASTM C 142
Material Finer than the 75-µm (No. 200) Sieve	Not applicable	Every 3 months	ASTM C 117
Impurities	Every 3 months	Not applicable	ASTM C 40 ASTM C 87

PROPERTY	FREQUENCY		TEST
	FINE AGGREGATE	COARSE AGGREGATE	
L.A. Abrasion	Not applicable	Every 6 months	ASTM C 131 ASTM C 535
Chert, less than 2.40 specific gravity	Every 6 months	Every 6 months	ASTM C 123
Coal and Lignite, less than 2.00 gravity	Every 6 months	Every 6 months	ASTM C 123
Potential Reactivity	Every 12 months	Every 12 months	ASTM C289

Note: Tests shall be performed for aggregate quality at the intervals indicated in the table or whenever the source of aggregates is changed.

b. Corrective Action for Aggregate Quality - If the result of a quality test fails to meet the requirements for quality immediately prior to start of concrete placement, production procedures or materials shall be changed and additional tests shall be performed until the material meets the quality requirements prior to proceeding with either mixture proportioning studies or starting concrete placement. After concrete placement commences, whenever the result of a test for quality fails the requirements, the test shall be rerun immediately. If the second test fails the quality requirement, the fact shall be reported to the Engineer and immediate steps taken to rectify the situation. Aggregates that do not meet the quality tests shall not be used without specific written approval of the Engineer.

#### Scales

a. Weighing Accuracy - The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every 3 months for conformance with the applicable requirements of paragraph BATCHING EQUIPMENT. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors.

b. Batching and Recording Accuracy - Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. The Contractor shall confirm that the calibration devices

described in paragraph BATCH PLANT for checking the accuracy of dispensed admixtures are operating properly.

c. Scales Corrective Action - When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

### Batch-Plant Control

The measurement of all constituent materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

### Concrete Mixture

a. Air Content Testing - Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or District inspector. Tests shall be made in accordance with ASTM C 231. Test results shall be plotted on control charts which shall at all times be readily available to the District. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single test result reaches either the upper or lower action limit a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the control chart for air content and the control chart for range, and for determining the need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph AIR CONTENT. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively.

The range between each two consecutive tests shall be plotted on a control chart for range where an upper warning limit is set at 2.0 percentage points and up upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Engineer and the air content at the mixer controlled as directed.

b. Air Content Corrective Action - Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as is practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the control chart range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted. All this shall be at no extra cost to the District.

c. Slump Testing - Each truck delivery of concrete shall be slump tested in accordance with ASTM C-143. If the concrete does not meet the specified slump, it shall be rejected and not used on the project. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or District's inspector. Test results shall be plotted on control charts which shall at all times be readily available to the District. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made on the same batch of concrete. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control chart for percent air and the chart for range, and for determining the need for any remedial action. An upper warning limit shall be set at 1/2 inch below the maximum allowable slump on separate control charts for percent air used for each type of mixture as specified in paragraph SLUMP, and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 1 inch. Samples for slump shall be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between mixer and the placement, correlation samples shall be taken at the placement

site as required by the Engineer and the slump at the mixer controlled as directed.

d. Slump Corrective Action - Whenever points on the control chart for slump reach the upper warning limit, an adjustment shall be immediately made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum W/C specified, based upon aggregates which are in a saturated surface-dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted and the Contractor shall take appropriate steps to bring the slump under control. Also, additional slump tests shall be made as directed. All this shall be at no additional cost to the District.

e. Temperature - The temperature of the concrete shall be measured when slump tests are conducted and when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064. The temperature shall be reported along with the compressive strength data.

f. Compressive-Strength Specimens - At least one set of test specimens shall be made each day on each different concrete mixture placed during the day. Additional sets of test cylinders shall be made, as directed by the Engineer, when the mixture proportions are changed or when low strengths have been detected. A random sampling plan shall be developed by the Contractor and approved by the Engineer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph DESIGN REQUIREMENTS shall consist of four cylinders, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. All compressive-strength tests shall be reported immediately to the Engineer. Quality control charts shall be kept for individual strength tests, moving average for strength, and moving average for range for each mixture. The charts shall be similar to those found in ACI 214.

g. Delivery - Ready-mix concrete shall be produced and delivered in conformance with the "Standard Specification for Ready-Mixed Concrete" ASTM C94, as applicable, with the following limitations. Concrete that has contained its mixing water for more than 45 minutes, or has achieved a temperature of 90 degrees F or higher, or has attained its initial set upon arrival at the jobsite, as determined by the Engineer, will be rejected.

Concrete shall meet the requirements of strength, mix design and consistency specified. In the event the concrete as delivered does not meet the slump requirements, it shall be rejected. No water shall be added after batching without approval of the Engineer. Batch out time of trucks shall be indicated on the delivery tickets at the concrete plant. A copy of the delivery ticket shall be given to the Engineer at the time of delivery. Concrete deliveries without the batch out time indicated on the ticket shall be rejected. Each truck delivery of concrete will be checked for slump and conformance with the approved mix design. If the concrete does not meet slump requirements or does not conform to the approved mix design, it will be rejected.

#### Inspection Before Placing

Foundation or construction joints, forms, and embedded items shall be inspected for quality by the Contractor in sufficient time prior to each concrete placement to certify to the Engineer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

#### Placing

a. Placing Inspection - The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, yardage placed, and method of placement.

b. Placing Corrective Action - The placing foreman shall not permit batching and placing to begin until he has verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

#### Vibrators

a. Vibrator Testing and Use - The frequency and amplitude of each vibrator shall be determined prior to initial use. The frequency shall be determined at the same time the vibrator is operating in concrete with the tachometer held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be

determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing.

b. Vibrator Corrective Action - Any vibrator not meeting the requirements of paragraph VIBRATORS shall be immediately removed from service and repaired or replaced.

#### Curing

a. Moist-Curing Inspections - At least once each shift, and once per day on nonwork days an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist-Curing Corrective Action - When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for such areas shall be extended by one (1) day.

c. Membrane-Curing Inspection - No curing compound shall be applied until the Contractor's authorized representative has verified that the compound is properly mixed and ready for spraying. At the end of each operation, he shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered and compute the rate of coverage in square feet per gallon. He shall note whether or not coverage is uniform.

d. Membrane-Curing Corrective Action - When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet-Curing Inspection - At least once each shift and once per day on nonwork days, an inspection shall be made of all areas being cured using material sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet-Curing Corrective Action - When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by one (1) day.

#### Cold-Weather Protection and Sealed Insulation Curing

At least once each shift and once per day on nonwork days, an inspection shall be made of all areas subject to cold-weather protection. The protection system shall be inspected for holes, tears, unsealed joints, or other deficiencies that could result in damage to the concrete. Special attention shall be taken at edges, corners, and thin sections. Any deficiencies shall be noted, corrected, and reported.

#### Cold-Weather Protection Corrective Action

When a daily inspection report lists any holes, tears, unsealed joints, or other deficiencies, the deficiency shall be corrected immediately and the period of protection extended 1 day.

#### Mixer Uniformity

a. Stationary Mixers - Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the longest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94.

b. Truck Mixers - Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C 94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

#### Mixer Uniformity Corrective Action

When a mixer fails to meet mixer uniformity requirements, either the mixer shall be removed from service on the work, the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

#### REPORTS

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in

preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Engineer has the right to examine all test and inspection records.

## DESIGN REQUIREMENTS

### CONCRETE STRENGTH

Specified compressive strength  $f'_c$  shall be as follows:

CLASS	COMPRESSIVE STRENGTH	STRUCTURE
AA	4,000 psi @ 28 days	Spillway cutoff wall, floodwall, box culvert, box culvert foundation slab, headwalls, wingwalls, aprons energy dissipater
A	3,000 psi @ 28 days	Manholes, footings for masonry walls
B	2,500 psi @ 28 days	Curbs, sidewalks, gutters, fence post footings
C	2,000 psi @ 28 days	Thrust blocks, encasement

Class of concrete used in various structures shall be as specified on the plans or elsewhere in the specifications.

### MAXIMUM WATER-CEMENT (W/C) RATIO

Maximum W/C shall be as follows:

WATER-CEMENT RATIO, BY MASS

STRUCTURE

0.45

Spillway cutoff wall, floodwall, box culvert,  
box culvert foundation slab, headwalls,  
wingwalls, aprons, energy dissipater

0.50

Curbs, sidewalks, gutters, manholes

These W/C's may cause higher strengths than that required by paragraph  
CONCRETE STRENGTH.

**CONSTRUCTION TOLERANCES**

GENERAL

The definitions of the terms used in the following tables shall be as defined in ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal. Tolerances are not cumulative. The most restrictive tolerance controls. Tolerances shall not extend the structure beyond legal boundaries. Except as specified otherwise, plus tolerance increases the amount or dimension to which it applies, or raises a level alignment, and minus tolerance decreases the amount or dimension to which it applied, or lowers a level alignment. A tolerance without sign means plus or minus. Where only one signed tolerance is specified, there is no limit in the other direction.

TOLERANCES FOR FOUNDATIONS

(1) Lateral alignment

Eccentricity measured from the center of gravity of footing as cast to the center of gravity as specified; 0.02 times width of footing in direction of misplacement but not more than

2 in

Supporting masonry construction

1/2 in.

(2) Level alignment

Top of footings supporting masonry

1/2 in.

Top of other footings

+1/2 in.  
-2 in.

(3) Cross-sectional dimensions

Horizontal dimension of formed members +2 in.  
-1/2 in.

Horizontal dimensions of unformed members cast against soil:

2 ft or less +3 in.  
-1/2 in.

Greater than 2 ft but less than 6 ft +6 in.  
-1/2 in.

Over 6 ft +12 in.  
-1/2 in.

Vertical dimension (thickness) -5 percent  
(-1 in.)

(4) Relative alignment

Slope of footing side and top surfaces with respect to the specified plane 1 in. per 10 ft

TOLERANCE FOR FINISHED FORMED CONCRETE SURFACES

(1) Vertical alignment

Formed surfaces slope with respect to the specified plane

Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view 1/4 in. in 10 ft

All other conditions 3/8 in. in 10 ft

(2) Abrupt variation

The offset between concrete surfaces for the following classes of surface:

(For Class AHV, positive means raise of elevation in the direction of waterflow, negative means drop of elevation in the direction of waterflow)

\*Class AHV, in the direction of waterflow +0 in.

	-1/8 in.
perpendicular to the direction of waterflow	1/8 in.
Class A	1/8 in.
Class B	1/4 in.
Class C	1/4 in.
Class D	1 in.

\*Includes any high-velocity (40 fps) waterflow on any surface.

(3) Gradual variation

Surface finish tolerances as measured by placing a freestanding (unleveled), 5-ft straightedge for plane surface or curved template for curved surface anywhere on the surface and allowing it to rest upon two high spots within 72 hr after concrete placement. The gap at any point between the straightedge or template and the surface shall not exceed:

*Class A (including Class AHV)	1/8 in.
Class B	1/4 in.
Class C	1/2 in.
Class D	1 in.

\*Includes any high-velocity (40 fps) waterflow on any surface.

TOLERANCES FOR BRIDGES, EROSION-PROTECTION STRUCTURES,  
AND SMALL HYDRAULIC STRUCTURES

(1) Vertical alignment

Exposed surfaces	3/4 in.
Concealed surfaces	1-1/2 in.

(2) Lateral alignment

Centerline alignment

1 in.

## APPEARANCE

Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method that does not harm the concrete and that is approved by the Engineer.

## PRODUCTS

## MATERIALS

### CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement, portland-pozzolan cement, portland blast-furnace slag cement, portland cement in combination with pozzolan or GGBF slag and shall conform to appropriate specifications listed below. Use of cementitious materials in architectural concrete shall be restricted to one color, one source, and one type.

#### Portland Cement

ASTM C 150, Type I or II, except that the maximum amount of C3A in Type I cement shall be 15 percent.

#### High-Early-Strength Portland Cement

ASTM C 150, Type III, used only when specifically approved in writing.

#### Pozzolan, Other than Silica Fume

Pozzolan shall conform to ASTM C 618, Class F, with the optional requirements for multiple factor, drying shrinkage, and uniformity of Table 2A. Table 1A requirement

for maximum alkalis shall apply when used with aggregates that require low-alkali cement.

#### Ground Granulated Blast-Furnace Slag

Ground Granulated Blast-Furnace (GGBF) Slag shall conform to ASTM C 989.

#### Blended Hydraulic Cement

Portland blast-furnace slag cement shall conform to ASTM C 595, Type IS.  
Portland-pozzolan cement shall conform to ASTM C 595, Type IP.

### AGGREGATES

#### General

Concrete aggregates may be furnished from any source capable of meeting the quality requirements as stated in paragraph QUALITY. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33. The nominal maximum size shall be as listed in paragraph NOMINAL MAXIMUM-SIZE COARSE AGGREGATE. Where the use of highway department gradations are permitted, proposed gradations shall be submitted for approval.

#### Concrete Aggregate Sources

Selection of Source - After the award of the contract, the Contractor shall designate in writing only one source or combination of sources from which he proposes to furnish aggregates. If the Contractor proposes to furnish aggregates from a source or from sources not listed at the end of this section, he may designate only a single source or single combination of sources for aggregates. Regardless of the source, selected samples for acceptance testing shall be provided as required by paragraph DISTRICT TESTING AND SAMPLING.

#### Quality

### TEST LIMITS

PROPERTY	FINE AGGREGATE	COARSE AGGREGATE	TESTS
Specific Gravity	2.4	2.4	ASTM C 127 ASTM C 128
Clay Lumps and Friable Particles	3.0%	2.0%	ASTM C 142
Material Finer than 75- $\mu$ m - (No. 200) Sieve	2.0%	1.0%	ASTM C 117
Organic Impurities	Not darker than No. 3 Not less than 95 percent		ASTM C 40 ASTM C 87
L. A. Abrasion		50	ASTM C 131 ASTM C 535

### CHEMICAL ADMIXTURES

Chemical admixtures to be used, when required or permitted, shall conform to the appropriate specification listed.

#### Air-Entraining Admixture

The air-entraining admixture shall conform to ASTM C 260 and shall consistently cause the concrete to have an air content in the specified ranges under field conditions.

#### Accelerating Admixture

Accelerators shall meet the requirements of ASTM C 494, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

#### Water-Reducing or Retarding Admixture

a. Water-Reducing or Retarding Admixtures: ASTM C 494, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

b. High-Range Water Reducing Admixture: ASTM C 494, Type F or G except that the 6-month and 1-year strength requirements shall be waived. The admixture may be used only when approved by the Engineer, such approval

being contingent upon particular mixture control as described in the Contractor's Quality Control Plan.

#### Other Chemical Admixtures

Other chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017, Type 1 or 2. These admixture shall be used only for concrete listed in paragraph SLUMP.

#### CURING MATERIALS

##### Impervious-Sheet Curing Materials

Impervious-sheet curing materials shall conform to ASTM C 171, type optional, except polyethylene film shall not be used.

##### Membrane-Forming Curing Compound

The membrane-forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint or coating specified. Nonpigmented compound shall contain a fugitive dye and shall have the reflective requirements in ASTM C 309 waived.

#### WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali.

#### NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107 and shall be a commercial formulation suitable for the application proposed.

## LATEX BONDING COMPOUND

Latex bonding compound agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

## EPOXY RESIN

Epoxy resin for use in repairs shall conform to ASTM C 881, Type III, Grade I or II.

## CONCRETE MIXTURE PROPORTIONING

### QUALITY OF MIXTURE

For each portion of the structure, mixture proportions shall be selected so that the strength and W/C requirements listed in paragraph DESIGN REQUIREMENTS are met.

### NOMINAL MAXIMUM-SIZE COARSE AGGREGATE

Nominal maximum-size coarse aggregate may be 1-½ or 1 inch except that ¾ inch nominal maximum-size coarse aggregate shall be used when any of the following conditions exist: the narrowest dimension between sides of forms is less than 7-½ inches, the depth of the slab is less than 4 inches, the minimum clear spacing between reinforcing is less than 2-¼ inches, or the minimum clear spacing between waterstop and subgrade or forms is less than 3 inches; or if in the opinion of the Engineer, inadequate consolidation can be achieved due to the large size of the aggregate.

### AIR CONTENT

Air content as delivered to the forms and as determined by ASTM C 231 shall be between 4 and 7 percent except that when the nominal maximum-size coarse aggregate is ¾ inch, it shall be between 4-½ and 7-½ percent. When the nominal maximum size of coarse aggregate is 1-½ inches, the air content of the sample measured in accordance with ASTM C 231 shall be 5-½ ± 1-½ percent.

## SLUMP

The slump shall be determined in accordance with ASTM C 143 and shall be a maximum of 4 inches for Class AA concrete and 5 inches for all other classes. Concrete may contain a chemical admixture for use in producing flowing concrete in accordance with ASTM C 1017, however, the slump of the concrete shall not exceed the above limits as measured at the discharge end of the pump hose.

## CONCRETE PROPORTIONING

Trial batches and testing requirements for various qualities of concrete specified shall be the responsibility of the Contractor. Samples of aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by the manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios, which will produce a range of strength encompassing those required for the work. The maximum water-cement ratios required in paragraph MAXIMUM WATER-CEMENT RATIO will be converted to a weight ratio of water to cement plus pozzolan by mass, silica fume, or GGBF slag by mass equivalency as described in ACI 211.1. In the case where GGBF slag is used, the weight of the slag shall be included in the equations for the term P, which is used to denote the mass of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent of the total cementitious material. Trial mixtures shall be proportioned for maximum permitted slump and air content with due consideration to the approved conveying and placement method. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 days and at the design age specified in paragraph DESIGN REQUIREMENTS in accordance with ASTM C 39. From these test results, a curve will be plotted showing the relationship between water-cement ratio and strength.

## REQUIRED AVERAGE COMPRESSIVE STRENGTH

In meeting the strength requirements specified in paragraph CONCRETE STRENGTH, the selected mixture proportion shall produce a required average

compressive strength  $f_{cr}$  exceeding the specified strength  $f_c$  by the amount indicated below.

### Average Compressive Strength from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified strength or strengths ( $f_c$ ) within 1,000 psi of that specified for proposed work, and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another test age designated for determination of  $f_c$ .

Required average compressive strength  $f_{cr}$  used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f_{cr} = f_c + 1.34S$$
$$f_{cr} = f_c + 2.33S - 500$$

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS*	MODIFICATION FACTOR FOR STANDARD DEVIATION
less than 15	see method below
15	1.16
20	1.08
25	1.03
30 or more	1.00

\*Interpolate for intermediate numbers of tests.

### Average Compressive Strength without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength  $f'_{cr}$  shall be determined as follows:

If the specified compressive strength  $f'_c$  is less than 3,000 psi,

$$f'_{cr} = f'_c + 1,000$$

If the specified compressive strength  $f'_c$  is 3,000 to 5,000 psi,

$$f'_{cr} = f'_c + 1,200$$

If the specified compressive strength  $f'_c$  is over 5,000 psi,

$$f'_{cr} = f'_c + 1,400$$

## EXECUTION

## EQUIPMENT

## CAPACITY

Minimum batching, mixing, conveying and placing equipment capacity is not specified, but information regarding this equipment is required to be submitted to the Engineer under Section SUBMITTALS.

## BATCH PLANT

Batch plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

## Batching Equipment

The batching controls shall be partially automatic, semiautomatic, or automatic. The semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with an accurate

recorder or recorders that meet the requirements of NRMCA CPMB 100. Separate bins or compartments shall be provided for each size group of aggregate and cement, pozzolan, and GGBF slag. Aggregates shall be weighed either in separate weigh batchers with individual scales or cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cement, pozzolan, or GGBF slag. If both cement and pozzolan or GGBF slag are used, they may be batched cumulatively provided that the portland cement is batched first. If measured by mass, the mass of the water shall not be weighed cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Admixtures shall not be combined prior to introduction in water. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment. All filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

#### Scales

The equipment for batching by mass shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. Tests shall be made at the frequency required in paragraph TESTS AND INSPECTIONS, and in the presence of a District inspector.

#### Batching Tolerances

##### a. Weighing Tolerances

MATERIAL	PERCENT OF REQUIRED MASS
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

b. Volumetric Tolerances - For volumetric batching equipment, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MASS
Water	Plus or minus 1 percent
Chemical admixtures	Zero to plus 6 percent

#### Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the masses of the materials being batched.

An electric moisture meter may be provided for measuring moisture in the fine aggregate. The sensing element shall be arranged so that the measurement is made near the batcher charging gate of the sand bin or in the sand batcher.

#### CONCRETE MIXERS

The concrete mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

#### Stationary Mixers

Concrete plant mixers shall be tilting, nontilting, horizontal-shaft, vertical-shaft, or pugmill and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94 applicable to central-mixed concrete.

#### Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete

mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

## Conveying Equipment

The conveying equipment shall conform to the following requirements:

### Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

### Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

### Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Nonagitating equipment may be used for transporting plant-mixed concrete over a smooth road when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

## Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Engineer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

## Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches. The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant trunk that is long enough to extend through the reinforcing bars.

## Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

## VIBRATORS

Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed in conformance with the following requirements:

APPLICATION	HEAD DIAMETER INCHES	FREQUENCY VPM	AMPLITUDE INCHES
Thin walls, beams, etc.	1-1/4 to 2-1/2	9,000 to 13,500	0.02 to 0.04

General construction      2 to 3-1/2      8,000 to 12,000      0.025 to 0.05

## PREPARATION FOR PLACING

### EMBEDDED ITEMS

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding, including tack welding, will not be permitted on embedded metals within 2 feet of the surface of the concrete.

### CONCRETE ON EARTH FOUNDATIONS

Earth surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the earth foundation shall have been satisfactorily compacted in accordance with the special provisions.

### CONCRETE ON ROCK FOUNDATIONS

Rock surfaces upon which concrete is to be placed shall be clean, free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached, or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Engineer, and to firm rock on the sides. Immediately before the concrete is placed, all rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as described in paragraph CONSTRUCTION JOINT TREATMENT. All rock surfaces shall be kept continuously wet for at least 24 hours immediately prior to placing concrete thereon. All approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. The mortar shall be covered with concrete before the time of initial setting of the mortar.

Unless otherwise shown on the plans or designated in the special provisions, minor structures which are furnished as precast structures shall be placed on a layer of

structure backfill (or aggregate base) at least six inches in depth. The layer shall have been shaped to fit the bottom surface of the precast unit and compacted to a density not less than 100 percent of the maximum density, as directed and approved by the Engineer. At the time the unit is placed, the moisture content of the layer shall be at or near the optimum moisture. After the unit has been initially set in place and checked for line and grade, it shall be removed and any defects in its bearing area shall be corrected by trimming and by placing and compacting similarly moistened structure backfill. The process of removal, correction and replacement shall continue until the imprint of the unit on the bearing area indicates essentially uniform contact, and the unit is in reasonable conformity with the lines and grades shown on the project plans.

## CONSTRUCTION JOINT TREATMENT

Construction joint treatment shall conform to the following requirements. Exposed construction joints shall be made straight and level or plumb except as shown otherwise on the drawings. Except as otherwise shown on the drawings, construction joints intersecting sloping exposed concrete surfaces shall be inclined near the exposed surface to prevent feathered edges. The angle between such an inclined surface and the form shall be not less than 50 degrees nor more than 130 degrees and the surface angle shall extend into the concrete member for at least 3 inches.

### Joint Preparation

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Air-water cutting will not be permitted on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean, well bonded coarse aggregate is exposed uniformly throughout the lift surface. The edges of the coarse aggregate shall not be undercut. The surface shall be washed clean again as the last operation prior to placing the next lift. There shall be no standing water on the surface upon which concrete is placed.

### Air-Water Cutting

Air-water cutting of a construction joint shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 90 to 110 psi, and the water pressure shall be just sufficient to bring the water into

effective influence of the air pressure. When approved by the Engineer, a retarder may be applied to the surface of the lift to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, the Contractor shall furnish samples of the material to be used and shall demonstrate the method to be used in applications. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure water jet or sandblasting will be required as the last operation before placing the next lift.

#### High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi may be used for cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

#### Wet Sandblasting

This method may be used when the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. The surface of the concrete shall then be washed thoroughly to remove all loose materials.

#### Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

### **PLACING**

#### PLACING PROCEDURES

The surfaces of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing concrete. Surfaces may be dampened immediately before placement if necessary. Concrete placement will

not be permitted when, in the opinion of the Engineer, weather conditions prevent proper placement and consolidation. Concrete shall be deposited as close as possible to its final position in the forms and, in so depositing, there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it may be effectively consolidated in horizontal layers 2.0 feet or less in thickness with a minimum of lateral movement. The amount deposited in each location shall be that which can be readily and thoroughly consolidated. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of cold joints while concrete is being placed. Concrete shall be placed by methods that will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper that is conical in shape. The concrete shall not be dropped vertically more than 5 feet, except where a properly designed and sized elephant truck with rigid drop chute bottom section is provided to prevent segregation and where specifically authorized. In no case will concrete be discharged to free-fall through reinforcing bars.

Concrete shall not be placed in standing water except with written permission from the Engineer, and the method of placing shall be subject to approval. Concrete shall not be placed in running water. Methods and equipment employed in depositing concrete shall minimize clusters of coarse aggregate. Clusters that occur shall be scattered before the concrete is vibrated. Forms shall be constantly monitored and their position adjusted as necessary during concrete placement. The Engineer reserves the right to require that concrete be placed in depths less than 2' as specified above where concrete cannot otherwise be placed and consolidated in accordance with the requirements of these specifications.

#### PLACEMENT BY PUMP

When concrete is to be placed by pump, the nominal maximum-size coarse aggregate shall not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms. Grout used to lubricate the pumping equipment at the beginning of the placement will not be incorporated into the placement.

#### TIME INTERVAL BETWEEN MIXING AND PLACING

Concrete shall be placed within 30 minutes after discharge into nonagitating equipment. When concrete is truck-mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work, and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregates. When the length of haul makes it impossible to deliver truck-mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site.

#### COLD-WEATHER PLACING

When cold-weather placing of concrete is likely to be subjected to freezing temperatures before the expiration of the curing period, it shall be placed in accordance with procedures previously submitted in accordance with paragraph SUBMITTALS. The ambient temperature of the space adjacent to the concrete placement and surfaces to receive concrete shall be above 32 degrees F. The placing temperature of the concrete having a minimum dimension less than 12 inches shall be between 55 and 75 degrees F when measured in accordance with ASTM C 1064. The placing temperature of the concrete having a minimum dimension greater than 12 inches shall be between 50 and 70 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete-placing temperatures. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals, or other materials shall not be mixed with the concrete to prevent freezing.

#### HOT-WEATHER PLACING

Concrete shall be properly placed and finished with procedures previously submitted in accordance with paragraph SUBMITTALS. The concrete temperature on arrival shall not exceed 90 degrees F when measured in accordance with ASTM C 1064. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph WATER-REDUCING OR RETARDING ADMIXTURES may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Under extreme conditions of high ambient temperature, exposure to the direct rays of the sun, low relative humidity, and wind, it may be necessary to restrict concrete placement to early morning only. *The Engineer will make this decision.* If this decision is made, then particular attention must be directed to the curing process

since the concrete will be exposed to severe thermal stresses due to temperature variation; heat of hydration plus midday sun radiation versus nighttime cooling.

Hot-weather placing requirements are required when a combination of air temperature, wind speed and low humidity result in concrete that has an accelerated rate of moisture loss and/or accelerated rate of cement hydration. Ambient conditions, as determined by the Engineer, that may impair the quality of the concrete will require the hot weather placing procedures to be followed.

## CONSOLIDATION

Immediately after placement, each layer of concrete, including flowing concrete, shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required, if necessary, with internal vibrating along formed surfaces permanently exposed to view. Form or surface vibrators shall not be used unless specifically approved. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding unhardened layer if such exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly.

## FINISHING

The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 40 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish. Additional finishing shall be as specified below and shall be true to the elevation shown in the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or as directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or jitterbugs shall not be used.

## STEEL TROWELED FINISH

A steel troweled finish shall be applied to the floor of the auxiliary outlet works box culvert.

When the floated surface has hardened sufficiently to prevent excess fine material from being drawn to the surface, and bleed water has evaporated, final floating and steel troweling shall be started. Steel troweling shall be performed with firm pressure so as to flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes and trowel marks. Except as hereinafter provided, surface irregularities shall not exceed  $\frac{1}{4}$  of an inch in height. Abrupt irregularities on surfaces shall be completely eliminated by grinding on a bevel of 1:20 ratio of height to length; provided, that grinding to a depth in excess of  $\frac{1}{4}$  of an inch will not be permitted, and any irregularity requiring grinding in excess of this limit shall in lieu of grinding, be excavated and removed to a sufficient depth below the finished grade, and the irregularity repaired as specified in MATERIAL AND PROCEDURE FOR REPAIRS. If any gradual irregularity on the foregoing surface is greater than the specified  $\frac{1}{4}$  inch limitation, the irregularity shall be reduced by grinding so that it is within the specified limit, providing that the grinding in excess of  $\frac{1}{4}$  of an inch will not be permitted and, instead such irregularity shall be excavated and repaired to the required surface levels as required by abrupt irregularity. The slopes produced by grinding gradual irregularities, and the slopes of such irregularities that are steeper than the bevels specified for ground surfaces produced in eliminating abrupt irregularities, shall be reduced by grinding so that they conform with such bevels. Where depressions in the finished surfaces occur, the depressions shall be excavated, properly prepared, and brought to the required surface levels as specified below. Abrupt irregularities that are not parallel to the direction of flow and which are offset into the flow shall not exceed  $\frac{1}{8}$  of an inch. If any such irregularity exceeds the  $\frac{1}{8}$  inch limitation, the entire irregularity shall be completely eliminated by grinding on a bevel of 1:30.

## UNFORMED SURFACES

### Float Finish

Surfaces shall be screeded and darried or bullfloated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true and even plane. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be made of magnesium or aluminum.

## FORMED SURFACES

Unless another finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired as described in paragraph FORMED SURFACE REPAIR.

Uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that is exposed to view or on which a special finish is required. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.

## FORMED SURFACE REPAIR

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

## Classes A, AHV, & B Finishes

Surfaces listed in SECTION 504 - STRUCTURAL CONCRETE FORMWORK and as shown to have classes A, AHV, and B finishes, *and all hydraulic structures including the floodwall, headwalls, wingwalls, aprons, energy dissipater and box culvert* shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 16 square inches in area and less than 1/2 inch deep and bug holes exceeding 1/2 inch in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of tie rods shall be reamed and filled with dry-packed mortar as specified in paragraph MATERIAL AND PROCEDURE FOR REPAIRS. Defective and unsound concrete areas larger than described shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

## Class C Finish

Surfaces listed in Section 504 - STRUCTURAL CONCRETE FORMWORK and as shown shall have defects repaired as follows: defective areas, voids, and honeycombs smaller than 24 square inches and less than 2 inches deep; bug holes exceeding 1-1/2 inches in diameter shall be chipped and filled with dry-packed mortar; and holes left by removal of the tie rods shall be chipped and filled with dry-packed mortar. Defective and unsound concrete areas larger than 24 square inches and deeper than 1-1/2 inches shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

#### Class D Finish

Surfaces listed in Section 504 - STRUCTURAL CONCRETE FORMWORK and as shown to have class D finish shall have surface defects repaired as follows: defective areas, voids, and honeycombs greater than 48 square inches in area or more than 2 inches deep shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

#### Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Engineer. It shall be thoroughly compacted into the prepared

void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 40 degrees F during placement, finishing, and curing. Other methods and materials for repair may be used only when approved in writing by the Engineer. Repairs of the so called "plaster-type" will not be permitted.

## **CURING AND PROTECTION**

### **GENERAL**

The Contractor shall furnish all materials and perform all work required for curing.

Formed concrete surfaces may be cured either by moist curing or by the use of white wax-base curing compound. All flat surfaces including the spillway control section shall be water cured for a minimum of seven days. Other surfaces of concrete that will remain permanently exposed shall be cured by the use of a clear, resin-based curing compound; either provide CRC-101 or an equal commercial product or water emulsified, resin-based curing compound.

Surfaces of construction joints shall be water cured or cured by covering with polyethylene film or by the use of white wax-base or clear water-emulsified, resin-base curing compound. Immediately prior to placement of concrete or grout on or against these surfaces, concrete shall be prepared in accordance with the section, JOINT PREPARATION.

Contraction joint surfaces and control joint surfaces shall be cured by the use of wax-base curing compound. All extraneous concrete accretions and other foreign materials shall be removed from the surfaces of contraction joints and control joints to provide a smooth, clean surface prior to application of the curing compound.

All concrete surfaces shall be treated as specified to prevent loss of moisture from the concrete until the required curing period has elapsed or until immediately prior to placement of other concrete or backfill against those surfaces. Only sufficient time to prepare construction joint surfaces and to bring them to a surface dry condition shall be allowed between discontinuance of curing and placement of adjacent concrete.

As soon as unformed concrete surfaces have been finished, as specified, and have attained a dull appearance free from bleed water and moist sheen, they shall be treated as specified herein.

Forms shall be removed within 24 hours after the concrete has hardened sufficiently to prevent structural collapse or other damage by careful form removal. Where require, repair of all minor surface imperfections shall be made immediately after form removal. Minor surface repair shall be completed within 2 hours after form removal and shall be immediately followed by the initiation of curing by the applicable method specified herein. Concrete surfaces shall be kept continuously moist after form removal until initiation of curing.

## DURATION

The length of the curing period shall be determined by the type of cementitious material, as specified below. Concrete shall be cured by an approved method.

Type of Cement	Curing Time
High early strength, except when fly-ash or GGBF slag is used	3 days
Type I portland cement	7 days
Type IS, Type IP cement	7 days
Portland cement blended with silica fume	7 days
Type II portland cement	14 days
Portland cement blended with 25 percent or less fly-ash or GGBF slag	14 days
Portland cement blended with more than 25 percent fly-ash or GGBF slag	21 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, and mechanical damage. All materials and equipment needed for adequate curing and protection shall be available and at the placement site prior to the start of concrete placement. Concrete shall be protected from the damaging effects of rain for 12 hours and from flowing water for 14 days. No fire or excessive heat including welding shall be permitted near or in direct contact with concrete or concrete embedments at any time.

## MOIST CURING

Moist-cured concrete shall be maintained continuously, not periodically, wet for the entire curing period. If water or curing materials stain or discolor concrete surfaces that are to be permanently exposed, they shall be cleaned as required in paragraph APPEARANCE. Where wooden form sheathing is left in place during curing, the sheathing shall be kept wet at all times. Where steel forms are left in place during curing, the forms shall be carefully broken loose from the hardened concrete and curing water continuously applied into the void so as to continuously saturate the entire concrete surface. Horizontal surfaces may be moist cured by ponding, by covering with a minimum uniform thickness of 2 inches of continuously saturated sand, or by covering with saturated nonstaining burlap or cotton mats. Horizontal construction joints may be allowed to dry for 12 hours immediately prior to the placing of the following lift. Silica fume concrete, if used, shall be moist-cured. Curing of silica fume concrete shall start immediately after placement.

#### MEMBRANE-FORMING CURING COMPOUND

Concrete may be cured with an approved membrane-forming curing compound in lieu of moist curing except for the spillway control section or on any surface to which a grout-cleaned finish is to be applied or other concrete is to be bonded, on any surface containing protruding steel reinforcement, on an abrasive aggregate finish, or any surface maintained at curing temperature by use of free steam.

#### Pigmented Curing Compound

A pigmented curing compound meeting the requirements of the above paragraph MEMBRANE-FORMING CURING COMPOUND may be used on surfaces that will not be exposed to view when the project is completed.

#### Nonpigmented Curing Compound

A nonpigmented curing compound containing a fugitive dye may be used on surfaces that will be exposed to view when the project is completed. Concrete cured with nonpigmented curing compound must be shaded from the sun for the first 3 days when the ambient temperature is 90 degrees F or higher.

#### Application

The curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the

cleaning of loose sand, mortar, and debris from the surface. The surfaces shall be thoroughly moistened with water, and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared and bleeding has stopped. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces that have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. All concrete surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other cause that will disrupt the continuity of the curing membrane.

#### EVAPORATION RETARDANT

Sheet curing shall not be used on vertical or near-vertical surfaces. All surfaces shall be thoroughly wetted and be completely covered with waterproof paper or polyethylene-coated burlap having the burlap thoroughly water-saturated before placing. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

#### COLD-WEATHER CURING AND PROTECTION

When the daily outdoor low temperature is less than 32 degrees F, the temperature of the concrete shall be maintained above 40 degrees F for the first 7 days after placing. In addition, during the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by observation of ambient and concrete temperatures indicated by suitable temperatures measuring devices furnished by the District as required and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor at such locations as may be directed.

## SETTING OF BASE PLATES AND BEARING PLATES

### SETTING OF PLATES

After being plumbed and properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be provided with full bearing with nonshrink grout. The space between the top of concrete or masonry-bearing surface and the bottom of the plate shall be approximately  $1/24$  of the width of the plate, but not less than  $1/2$  inch for plates less than 12 inches wide. Concrete surfaces shall be rough, clean, and free of oil, grease, and laitance, and they shall be damp. Metal surfaces shall be clean and free of oil, grease, and rust.

### NONSHRINK GROUT APPLICATION

Nonshrink grout shall conform to the requirements of paragraph NONSHRINK GROUT. Water content shall be the minimum that will provide a flowable mixture and fill the space to be grouted without segregation, bleeding, or reduction of strength.

### Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or masonry-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for retaining the grout and shall be removed after the grout has set. If grade "A" grout as specified in ASTM C 1107 is used, all surfaces shall be formed to provide restraint. The placed grout shall be worked to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

### Treatment of Exposed Surfaces

After the grout has set, those types containing metallic aggregate shall have the exposed surfaces cut back 1 inch and immediately covered with a parge coat of mortar proportioned by mass of one part portland cement, two parts sand, and sufficient water to make the mixture placeable. The parge coat shall have a smooth, dense finish. The exposed surface of other types of nonshrink grout shall have a smooth, dense finish.

#### Curing

Grout and parge coats shall be cured in conformance with paragraph CURING AND PROTECTION.

#### TESTS AND INSPECTIONS

Tests and inspections shall conform to the requirements specified in the Construction Quality Assurance section of the special provisions.

#### MEASUREMENT AND PAYMENT

Concrete will be measured for payment based upon the actual volume of concrete within the pay lines of the structures as indicated on the drawings or as actually built. Measurement of concrete placed against the sides of any excavation without the use of intervening forms shall be made only within the pay lines of the structure. No deductions shall be made for rounded or beveled edges, space occupied by metal work, electrical conduits or reinforcing steel, or for voids or embedded items that are either less than 5 cubic feet in volume or 1 square foot in cross section. Delivery tickets for concrete shall be submitted.

Unit of measure: cubic yards to the nearest whole yard.

Payment will be made for costs associated with completing the concrete work as shown on the plans. However, these costs will not include the cost of embedded parts that are specified to be paid for separately. No payment will be made for concrete, as such, that is placed in structures for which payment is made as a lump sum, each, lineal foot, square foot or square yard.

**ITEM 505-1 - CONCRETE, CLASS AA (F'C = 4,000 PSI)**

**ITEM 505-2 - CONCRETE, CLASS C (F'C = 2,000 PSI)**

The length of box culvert shall be measured in linear feet of structure in place, completed and approved. It shall be measured along the centerline of the structure at the invert in the center of the structure, from beginning or inside face of the structure to the end or inside face of structure, whichever is applicable.

Payment for box culvert shall include full compensation for all labor, material, tools, equipment, and appurtenances necessary for the design and construction of the box culvert, transporting, installing to provide a concrete structure complete in place including all concrete and reinforcing steel according to the plans, details, and these specifications; and shall be made at the unit price bid per lineal foot to the nearest foot.

#### **ITEM 505-3 - 10'X 4' BOX CULVERT (ADOT B-02.10)**

The steps will be measured by the lump sum. Payment for pre-cast or cast in place concrete steps shall include full compensation for all labor, material, tools, equipment, and appurtenances necessary for the design and construction of the steps, transporting, installing to provide a concrete structure complete in place including all concrete and reinforcing steel, bedding and subgrade preparation and other incidentals according to the plans, details, and these specifications; and shall be made at the unit price bid.

#### **ITEM 505-4 - CONCRETE STEPS**

### **SECTION 510 - CONCRETE BLOCK MASONRY**

#### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-04200 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Work within this section shall consist of constructing a new masonry retaining wall at the Amphitheater and raising the masonry wall in front of the gymnasium.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### ACI INTERNATIONAL (ACI)

ACI SP-66 (1994) ACI Detailing Manual

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1995a) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153 (1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615/A 615M (1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 90 (1996a) Loadbearing Concrete Masonry Units

ASTM C 91 (1996) Masonry Cement

ASTM C 140 (1996b) Sampling and Testing Concrete Masonry Units

ASTM C 270 (1997) Mortar for Unit Masonry

ASTM C 476 (1995) Grout for Masonry

ASTM C 494 (1992) Chemical Admixtures for Concrete

ASTM C 641 (1982; R 1991) Staining Materials in Lightweight Concrete Aggregates

ASTM C 780 (1996) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1019 (1989a; R 1993) Sampling and Testing Grout

ASTM C 1072 (1994) Measurement of Masonry Flexural Bond Strength

ASTM D 2000

(1996) Rubber Products in Automotive Applications

ASTM D 2240

(1997) Rubber Property - Durometer Hardness

ASTM E 447

(1992b) Compressive Strength of Masonry Prisms

## SUBMITTALS

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 110 SUBMITTAL PROCEDURES:

### SD-01 Data

Concrete Brick; DA.

Manufacturer's descriptive data. FIO

### SD-04 Drawings

Masonry Work; DA.

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

### SD-13 Certificates

Concrete Masonry Units (CMU) FIO

Control Joint Keys; FIO

Anchors, Ties, and Bar Positioners; FIO

Expansion-Joint Materials; FIO

Joint Reinforcement; FIO

Reinforcing Steel Bars and Rods; FIO  
Masonry Cement; FIO  
Mortar Coloring; FIO  
Mortar Admixtures; FIO  
Grout Admixtures; FIO

Certificates of compliance stating that the materials meet the specified requirements.

## **DELIVERY, HANDLING, AND STORAGE**

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

## **MASONRY UNITS**

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite.

## **REINFORCEMENT, ANCHORS, AND TIES**

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

## **CEMENTITIOUS MATERIALS, SAND AND AGGREGATES**

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

## **PRODUCTS**

## GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Engineer's approval.

## CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I.

## AGGREGATES

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

## KINDS AND SHAPES

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated.

## MORTAR

Mortar shall be Type S in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Aggregates shall be from one source.

## Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

## GROUT

Grout shall conform to ASTM C 476. Grout slump shall be between 8 and 10 inches. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

### Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

### Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

## ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

### Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

## REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

## EXECUTION

## ENVIRONMENTAL REQUIREMENTS

### HOT WEATHER INSTALLATION

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; sand for grout shall be kept watered, mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

### COLD WEATHER INSTALLATION

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

#### Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

- a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.
- b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120

degrees F. Temperature of mortar on boards shall be maintained above freezing.

- c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.
- d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

#### Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistant membrane.
- b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.
- d. Mean Daily Temperature 20 Degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

#### LAYING MASONRY UNITS

Masonry units shall be laid to match the existing bond pattern or in a running bond pattern. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting

from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

## SURFACE PREPARATION

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch.

## FORMS AND SHORES

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

## CONCRETE MASONRY UNITS

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

## TOLERANCES

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II  
TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises

In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top surfaces of bearing walls

In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines

In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of columns and in thickness of walls

Minus	1/4 inch
Plus	1/2 inch

CUTTING AND FITTING

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

## JOINTING

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

### Flush Joints

Joints in concealed masonry surfaces shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall.

### Tooled Joints

Joints in exposed exterior surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

## JOINT WIDTHS

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

## EMBEDDED ITEMS

Spaces around built-in items shall be filled with mortar. Anchors, ties, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully

embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

## UNFINISHED WORK

Unfinished work shall be stepped back for joining with new work. Tothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

## MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

## REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

## POSITIONING BARS

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

## SPLICES

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

## PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

## GROUT HOLES AND CLEANOUTS

### Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

### Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are

stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

## GROUTING EQUIPMENT

### Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

### Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

## GROUT PLACEMENT

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

### Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state.

## **POINTING AND CLEANING**

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

## **CONCRETE MASONRY UNIT**

Exposed concrete masonry unit shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

## **PROTECTION**

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

## **CURING**

Newly constructed masonry shall be kept damp for at least 5 days with a nozzle regulated fog spray sufficient only to moisten faces of the masonry but not of such quantity as to cause water to flow down over the masonry.

## **MEASUREMENT AND PAYMENT**

Measurement shall be by the linear foot of wall of a given size and type along the centerline including terminal sections, with deductions for openings.

The price paid per linear foot for masonry wall shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in constructing the wall complete in place as shown on the plans and specified herein. The cost to furnish and place concrete, grout, mortar and reinforcing steel for the wall footing, weep holes and drainage gravel, structural excavation and backfill, cutting or modifying existing adjacent walls, sidewalks, curbs, footings, or interfering irrigation lines and all other work required to construct the walls as shown on the plans and in these specifications shall be included.

**ITEM 510-1 - 4 COURSE BLOCK WALL**

**ITEM 510-2 - 3 COURSE BLOCK WALL**

**ITEM 510-3 - 2 COURSE BLOCK WALL**

**ITEM 510-4 - 1 COURSE BLOCK WALL**

**ITEM 510-5 - MASONRY RETAINING WALL**

No separate payment will be made for masonry construction items not included in the bid items above and the cost of these miscellaneous items shall be included in the cost of the appurtenant work.

## **SECTION 515 - STEEL STRUCTURES**

### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-05055 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

The work under this section includes the fabrication and installation of trashracks on the principal and auxiliary spillways, and other miscellaneous metal items.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 325	(1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 380	(1994a) Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D 962	(1981; R 1994) Aluminum Powder and Paste Pigments for Paints

### ASME INTERNATIONAL (ASME)

ASME B4.1 (1967; R 1994) Preferred Limits and Fits for Cylindrical Parts

ASME B46.1 (1985) Surface Texture (Surface Roughness, Waviness, and Lay)

#### AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

AWS D1.2 (1990) Structural Welding Code - Aluminum

#### SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3110 (1992; Rev G) Primer Zinc Chromate

SAE AMS 3132 (1994; Rev F) Varnish, Phenolic Resin Corrosion-Preventive

#### **SUBMITTALS**

District approval is required for all submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 110 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Detail Drawings; DA.

Detail drawings for metalwork and machine work shall be submitted and approved prior to fabrication.

##### SD-07 Schedules

Materials Orders; FIO.

Copies of purchase orders, mill orders, shop orders and work orders for materials shall be submitted prior to the use of the materials in the work.

Materials List; FIO.

Materials list for fabricated items shall be submitted at the time of submittal of detail drawings.

Shipping Bill; FIO.

Shipping bill shall be submitted with the delivery of finished pieces to the site.

#### SD-09 Reports

Tests, Inspections, and Verifications; FIO.

Certified test reports for materials shall be submitted with all materials delivered to the site.

### **METALWORK AND MACHINE WORK DETAIL DRAWINGS**

Detail drawings for metalwork and machine work shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the detail drawings.

### **PRODUCTS**

### **MATERIALS**

#### MATERIALS ORDERS

The Contractor shall furnish 3 copies of purchase orders, mill orders, shop orders and work orders for all materials orders and items used in the work. Where mill tests are required purchase orders shall contain the test site address and the name of the testing agency.

#### MATERIALS LIST

The Contractor shall furnish a materials list of the materials to be used in the fabrication of each item.

### **SHIPPING BILL**

The Contractor shall furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each item, the number of items, the total weight, and the car initial and number if shipped by rail in carload lots.

## FABRICATION

### STRUCTURAL FABRICATION

Material must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch unless otherwise approved. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

### Dimensional Tolerances for Structural Work

Dimensions shall be measured by an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown by not more than 1/16 inch for members 30 feet or less in length and by more than 1/8 inch for members over 30 feet in length.

### Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and

notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1, Subsection 3.2. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Hand-guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal.

## WELDING

### Welding of Structural Steel

Welding of structural steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal and shall conform to the applicable provisions of AWS D1.1, Sections 1 through 7, 9, 10 and 11. Welding shall be such as to minimize residual stresses, distortion and shrinkage.

#### Welding Technique

- (1) Filler Metal - The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used or shall be as shown where a specific choice of AWS specification allowables is required. The AWS designation of the electrodes to be used shall be included in the schedule of welding procedures. Only low hydrogen electrodes shall be used for manual shielded metal-arc welding regardless of the thickness of the steel. A controlled temperature storage oven shall be used at the job site as prescribed by AWS D1.1, Subsection 4.5 to maintain low moisture of low hydrogen electrodes.
- (2) Preheat and Interpass Temperature - Preheating shall be performed as required by AWS D1.1, Subsection 4.2 and 4.3 or as otherwise specified except that the temperature of the base metal shall be at least 70 degrees F. The weldments to be preheated shall be slowly and uniformly heated by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.
- (3) Stress-Relief Heat Treatment - Where stress relief heat treatment is specified or shown, it shall be in accordance with the requirements of AWS D1.1, Subsection 4.4 unless otherwise authorized or directed.
- d. Workmanship - Workmanship for welding shall be in accordance with AWS D1.1, Section 3 and other applicable requirements of these specifications.

(1) Preparation of Base Metal - Prior to welding the Contractor shall inspect surfaces to be welded to assure compliance with AWS D1.1, Subsection 3.2.

(2) Temporary Welds - Temporary welds required for fabrication and erection shall be made under the controlled conditions prescribed for permanent work. Temporary welds shall be made using low-hydrogen welding electrodes and by welders qualified for permanent work as specified in these specifications. Preheating for temporary welds shall be as required by AWS D1.1 for permanent welds except that the minimum temperature shall be 120 degrees F in any case. In making temporary welds arcs shall not be struck in other than weld locations. Each temporary weld shall be removed and ground flush with adjacent surfaces after serving its purpose.

(3) Tack Welds - Tacks welds that are to be incorporated into the permanent work shall be subject to the same quality requirements as the permanent welds and shall be cleaned and thoroughly fused with permanent welds. Preheating shall be performed as specified above for temporary welds. Multiple-pass tack welds shall have cascaded ends. Defective tack welds shall be removed before permanent welding.

## BOLTED CONNECTIONS

### Bolted Structural Steel Connections

Bolts, nuts and washers shall be of the type specified or indicated. All nuts shall be equipped with washers except for high strength bolts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated the materials, workmanship and installation shall conform to the applicable provisions of ASTM A 325 or ASTM A 490.

a. Bolt Holes - Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.

(1) Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger than the diameter of the bolt.

(2) Holes for fitted bolts shall be match-reamed or drilled in the shop. Burrs resulting from reaming shall be removed. The threads of bolts shall be entirely outside of the holes. The body diameter of bolts shall have tolerances as recommended by ASME B4.1 for the class of fit specified. Fitted bolts shall be fitted in reamed holes by selective assembly to provide an LN-2 fit.

(3) Holes for high strength bolts shall have diameters of not more than 1/16 inch larger than bolt diameters. If the thickness of the material is not greater than the diameter of the bolts the holes may be punched. If the thickness of the material is greater than the diameter of the bolts the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed for slight mismatching.

## MISCELLANEOUS PROVISIONS

### Metallic Coatings

a. Zinc Coatings - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A 123. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 2 ounces shall be repaired in accordance with ASTM A 780.

### Cleaning of Corrosion-Resisting Steel

Oil, paint and other foreign substances shall be removed from corrosion-resisting steel surfaces after fabrication. Cleaning shall be done by vapor degreasing or by the use of cleaners of the alkaline, emulsion or solvent type. After the surfaces have been cleaned they shall be given a final rinsing with clean water followed by a 24 hour period during which the surfaces are intermittently wet with clean water and then allowed to dry for the purpose of inspecting the clean surfaces. The surfaces shall be visually inspected for evidence of paint, oil, grease, welding slag, heat treatment scale, iron rust or other forms of contamination. If evidence of foreign substance exist the surface shall be cleaned in accordance with the applicable provisions of ASTM A 380. The proposed method of treatment shall be furnished for approval. After treatment the surfaces shall be visually reinspected. Brushes used to remove foreign substances shall have only stainless steel or nonmetallic bristles. Any contamination occurring subsequent to the initial cleaning shall be removed by one or more of the methods indicated above.

## Lubrication

The arrangement and details for lubrication shall be as shown. Before erection or assembly all bearing surfaces shall be thoroughly cleaned and lubricated with an approved lubricant.

## SHOP ASSEMBLY

Each machinery and structural unit furnished shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown. Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Errors or defects disclosed shall be immediately remedied by the Contractor without cost to the District. Before disassembly for shipment each piece of a machinery or structural unit shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

## TESTS, INSPECTIONS, AND VERIFICATIONS

### INSPECTION OF STRUCTURAL STEEL WELDING

#### Visual Examination

All visual examination of completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure compliance with the requirements of AWS D1.1, Section 3 and Section 9, Part D.

#### Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection the District reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the District.

## STRUCTURAL STEEL WELDING REPAIRS

Defective welds in the structural steel welding repairs shall be repaired in accordance with AWS D1.1, Subsection 3.7. Defective weld metal shall be removed to sound metal by use of air carbon-arc or oxygen gouging. Oxygen gouging shall not be used on ASTM A 514/A 514M steel. The surfaces shall be thoroughly cleaned before welding. Welds that have been repaired shall be retested by the same methods used in the original inspection.

## EXECUTION

## INSTALLATION

All parts to be installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Holes and grooves for lubrication shall be cleaned. Enclosed chambers or passages shall be examined to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly but care shall be taken not to overstress the threads. When a half nut is used for locking a full nut the half nut shall be placed first and followed by the full nut. Threads of all bolts except high strength bolts, nuts and screws shall be lubricated with an approved lubricant before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

## ALIGNMENT AND SETTING

Each machinery or structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Machines shall be set true to the elevations shown.

## BLOCKING AND WEDGES

All blocking and wedges used during installation for the support of parts to be grouted in foundations shall be removed before final grouting unless otherwise directed. Blocking and wedges left in the foundations with approval shall be of steel or iron.

## FOUNDATIONS AND GROUTING

Concreting of subbases and frames and the final grouting under parts of machines shall be in accordance with the procedures as specified in SECTION 505 CONCRETE STRUCTURES.

## PROTECTION OF FINISHED WORK

### MACHINED SURFACES

Machined surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means. Finished surfaces of ferrous metals to be in bolted contact shall be washed with an approved rust inhibitor and coated with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods. Finished surfaces of metals which shall be exposed after installation except corrosion resisting steel or nonferrous metals shall be painted as specified in MAG SECTION 530 PAINTING.

### LUBRICATION AFTER ASSEMBLY

After assembly all lubricating systems shall be filled with the lubricant specified and additional lubricant shall be applied at intervals as required to maintain the equipment in satisfactory condition until acceptance of the work.

### ALUMINUM

Aluminum that shall be in contact with grout or concrete shall be protected from galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. Aluminum in contact with structural steel shall be protected against galvanic or corrosive action by being given a coat of zinc-

chromate primer and a coat of aluminum paint. The zinc-chromate primer shall conform to SAE AMS 3110. The aluminum paint shall consist of a aluminum paste conforming to ASTM D 962, spar varnish conforming to SAE AMS 3132 and thinner compatible with the varnish. The aluminum paint shall be field mixed in proportion of 2 pounds of paste, not more than one gallon of spar varnish and not more than one pint of thinner.

## **TESTS**

## **WORKMANSHIP**

Workmanship shall be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

## **PRODUCTION WELDING**

Production welding shall conform to the requirements of AWS D1.1 or AWS D1.2 as applicable. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production items (flat, vertical, overhead or sloping). Test and production stud welding will be subjected to visual examination or inspection. If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

## **MEASUREMENT AND PAYMENT**

Payment will be made at the contract lump sum price for the bid items listed below, for costs associated with metalwork fabrication and machine work not specifically provided for elsewhere, which includes costs for materials, fabricating work, shop and field painting, galvanizing or other metallic coatings and the installation of metal items shown or required by these specifications unless otherwise specified.

**ITEM 515-1 - TRASHRACK AT PRINCIPAL OUTLET  
WORKS**

**ITEM 515-2 - TRASHRACK AT AUXILIARY OUTLET  
WORKS**

Payment will be made at the contract unit price per lineal foot for the bid items listed below, for costs associated with metalwork fabrication and machine work not specifically provided for elsewhere, which includes costs for materials, fabricating work, shop and field painting, and the installation of metal items shown or required by these specifications unless otherwise specified.

### **ITEM 515-3 - STEEL HANDRAIL**

No separate payment will be made for metalwork fabrication and installation not included in the bid items above and the cost of these miscellaneous items shall be included in the cost of the appurtenant work.

## **SECTION 540 - DESERT VARNISH**

### **DESCRIPTION**

The work under this section shall consist of furnishing all materials, equipment and labor necessary for the application of a penetrating desert varnish stain to concrete structures within the project limits as determined by the Contract Administrator and in accordance with the requirements of these Special Provisions.

### **MATERIALS**

### **GENERAL REQUIREMENTS**

The proposed desert varnish stain material shall meet the requirements specified herein. As basis for approval, manufacturers of such products shall provide independent laboratory test reports certifying compliance of their stain product with each of the physical, chemical and performance requirements specified,

Prior to application of the stain, the Contractor shall provide the Engineer with a Certificate of Compliance. The material supplied shall meet the requirements listed herein. Submittal of product data sheets listing the application or use requirements, the stain constituents and their proportions as well as material safety data sheets is required for the stain material supplied. The Contractor shall submit the name of the manufacturer of the desert varnish stain he proposes to use, along

with three sets of the manufacturer's specifications for mixing and application, to the Engineer for written approval. Approval of the stain material will not occur until all required documentation has been received by the Contract Administrator.

Desert varnish stain will be sampled and tested on a lot basis. At least one sample, not less than one quart in size, will be taken and tested. Random samples may be taken at the discretion of the Contract Administrator.

The Contract Administrator will select the desired color intensity of the stain. The Contractor shall not acquire the materials to stain the surfaces until he has received written notification of the final color selection from the Contract Administrator.

The desert varnish stain shall be ready-mixed at the manufacturer's plant. The stain shall be furnished in new, air-tight containers, clearly labeled with the exact title of the stain, Federal Specifications Number when applicable, name and address of the manufacturer and lot or batch number. The containers shall meet the U.S. Department of Transportation's Hazardous Material Shipping Regulations when applicable to the product. Precautions concerning the handling of the stain shall be shown on the label of the stain containers.

Containers shall be stored at temperatures in accordance with the manufacturer's written recommendation and shall not be opened until ready for use.

## **PHYSICAL AND CHEMICAL REQUIREMENTS**

The desert varnish material shall be an aqueous solution containing salts of iron and manganese, built in oxidizers and other trace elements including copper and zinc. The desert varnish stain shall involve applying a stable, one- or two-step component solution directly to concrete or rock.

## **PERFORMANCE REQUIREMENTS**

The projected life expectancy of the stain shall be a minimum of 50 years. The stain shall develop full coloration within two weeks after the application. The final color of the stain shall be controlled or modified by custom blending of the basic ingredients, application techniques, dilution rate of the color concentrate with water or a combination of these methods.

Chemical components within the stain shall have no adverse reactions or effects on the soils, plants or animals. No corrosive by-products shall be present once the stain has been applied, only nitrate fertilizer products shall be present as soluble residues.

## **CONSTRUCTION REQUIREMENTS**

The intent of the staining is to mitigate some of the effects of the construction. This work will consist of staining the new concrete structures within the project limits and as determined by the Contract Administrator.

Desert varnish stain shall be applied by an Arizona licensed painting Contractor or manufacturer's representative applicator, who has a minimum of one year of experience in the application of desert varnish stains, as approved by the Engineer. The stain shall be applied in accordance with the manufacturer's specifications. The methods of application along with the rate of application, and the surface temperature range of application shall be in accordance with the manufacturer's written recommendations. Three copies of the manufacturer's written recommendations shall be furnished to the Engineer prior to the start of the staining. The Contractor shall cover and/or protect all other surfaces existing and new, including vegetation, from the application of the stain.

As directed by the Engineer, the Contractor shall conduct sample stain tests on concrete surfaces. The stain tests shall be left for a minimum of two weeks for observation. The stain for the test shall be applied using the same methods that will be used to stain the work. The sample tests shall be approved by the Contract Administrator. The Contractor shall not begin staining until final approval of the product is received from the Contract Administrator. Shade and tone adjustments shall be made in accordance with aesthetic considerations, and final approval may require such adjustments.

The various surfaces to be stained shall be cleaned, prior to the stain being applied, in accordance with the manufacturer's written recommendations for the removal of all dirt, dust, efflorescence scale or other foreign substances which could be detrimental to the stain penetration or color. All surfaces to be stained shall be clean, completely dry, and free of frost or other foreign substances at the time of the application of the stain. After all surfaces have been prepared for the application of the stain and prior to the application, the Contractor and a representative from the manufacturer of the stain shall inspect the surfaces to be stained and, if in agreement, shall notify the Contract Administrator in writing that the surfaces are satisfactory for the stain to be applied. The Contractor shall not commence application of the stain without specific direction from the Contract Administrator.

## **MEASUREMENT AND PAYMENT**

Payment will be made at the contract lump sum price for the bid items listed below, for all labor, materials, equipment, tools, and incidentals necessary to complete the work specified herein.

## ITEM 540-1 - DESERT VARNISH

### SECTION 601 - TRENCH EXCAVATION, BACKFILLING AND COMPACTION

#### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02316 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017

(1988; R 1993) Water Content of Soil and Rock  
in Place by Nuclear Methods (Shallow Depth)

## **DEGREE OF COMPACTION**

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698.

## **PRODUCTS**

## **MATERIALS**

### **SATISFACTORY MATERIALS**

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, CL-ML.

### **UNSATISFACTORY MATERIALS**

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Engineer shall be notified of any contaminated materials.

### **COHESIONLESS AND COHESIVE MATERIALS**

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

## UNYIELDING MATERIAL

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

## UNSTABLE MATERIAL

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

## INITIAL BACKFILL MATERIAL

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

## PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. TAPE COLOR

Color	Utility
Red	Electric
Yellow	Gas, Oil, Dangerous Materials
Orange	Telephone, Telegraph, Television, Police, Fire

Communications

Blue Water Systems

Green Sewer Systems

## EXECUTION

## EXCAVATION

Excavation shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the District.

## TRENCH EXCAVATION REQUIREMENTS

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the District.

## Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Stones 75 mm (3 inches) or greater shall be removed. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

## Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

## Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 6 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe.

## Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the District.

## Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or other structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed.

Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

## **STOCKPILES**

Stockpiles of satisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the District. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Engineer.

## **BACKFILLING AND COMPACTION**

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

## **TRENCH BACKFILL**

Trenches shall be backfilled to the grade shown.

### **Replacement of Unyielding Material**

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

### **Replacement of Unstable Material**

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

#### Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

#### Final Backfill

The remainder of the trench shall be backfilled with satisfactory material and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils, except under pavements and within the dam embankment where it shall be compacted to 95 percent maximum density for cohesive or cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified above. Where it is necessary, in the opinion of the Engineer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

#### BACKFILLING PIPE IN FILL SECTIONS

Unless specifically noted on the plans or in the specifications, pipe shall be installed in a trench. For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below.

The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches.

### **BACKFILL FOR APPURTENANCES**

After the manhole, catchbasin, inlet, or similar structure has been constructed, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### **MOVEMENT OF CONSTRUCTION MACHINERY**

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over any pipe or pipeline structure at any stage of construction shall be at the Contractor's risk. Any damaged pipe or structure shall be repaired or replaced.

### **SPECIAL REQUIREMENTS**

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

### **PLASTIC MARKING TAPE**

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

## **TESTING**

### **TESTING OF BACKFILL MATERIALS**

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 1557. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

### **FIELD DENSITY TESTS**

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 1,000 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Engineer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Engineer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the District.

## **SECTION 605 - SUBDRAINAGE**

### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02620 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the District's authorized representative.*

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 252 (1994) Corrugated Polyethylene Drainage Tubing

AASHTO M 294 (1994) Corrugated Polyethylene Pipe, 305-to 915-mm (12-to 36 in.) Diameter

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3212 (1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM F 405 (1996) Corrugated Polyethylene (PE) Tubing and Fittings

ASTM D 1557 (1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))

ASTM D 2167 (1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2922 (1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

## SUBMITTALS

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 110 SUBMITTAL PROCEDURES:

#### SD-13 Certificates

Pipe for Subdrains; DA

Certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe, drain tile, fittings, and filter fabric.

#### SD-14 Samples

Pipe for Subdrains; FIO

Samples of pipe and pipe fittings, before starting the work.

### **DELIVERY, STORAGE, AND HANDLING**

#### DELIVERY AND STORAGE

Materials delivered to site shall be inspected for damage, unloaded, and stored with minimum handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. The storage area shall protect the fabric from mud, soil, dust, and debris. Plastic pipe shall be installed within 6 months from the date of manufacture unless otherwise approved.

#### HANDLING

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried and not dragged to the trench.

### **PRODUCTS**

#### **PIPE FOR SUBDRAINS**

Pipe for subdrains shall be corrugated polyethylene tubing, couplings and fittings for use in subsurface drainage systems conforming to AASHTO M 252. Perforated pipe shall be Type SP and unperforated pipe shall be Type S. Sizes shall be as indicated on the plans.

#### Pipe Perforations

Water inlet area shall be a minimum of 1.0 square inch per linear foot. Perforations shall be Class 2 slots. Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch nor be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing, 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing, and 2-1/2 inches on 10 inch diameter tubing. Slots shall be centered in the valleys of the corrugations of profile wall pipe.

#### Pipe Fittings

Fittings shall be designed for and supplied by the pipe manufacturer. Silt tight joints are required. Joint design shall be bell and spigot with an elastomeric rubber gasket meeting ASTM F 477. All fittings and joint design shall pass a laboratory pressure test of 2 psi using ASTM D 3212 modified to 2 psi. Field pressure testing of the installed pipe and joints is not required.

### **SUBDRAIN FILTER AND BEDDING MATERIAL**

Subdrain filter and bedding material shall conform to the requirements in Section 205 - EMBANKMENT FOR EARTH DAMS.

### **EXECUTION**

#### **EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS**

Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Bedding for corrugated polyethylene pipe and pipe arch

shall be in accordance with ASTM A 798/A 798M. It is not required to shape the bedding to the pipe geometry. Compaction of the bedding material shall be as specified for cohesionless material in Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION.

## INSTALLATION OF PIPE FOR SUBDRAINS

### Pipelaying

Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. Pipe shall not be laid in water, and shall be laid when the trench conditions or weather is unsuitable for such work. Water shall be removed from trenches by sump pumping or other approved methods. The pipe shall be laid to the grades and alignment as indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. The pipe shall be bedded to the established gradeline. Perforations shall be centered on the bottom of the pipe. Pipes of either the bell-and-spigot type or the tongue-and-groove type shall be laid with the bell or groove ends upstream. All pipes in place shall be approved before backfilling.

Maximum allowable deflection of installed corrugated pipe shall be 5%. Not less than 30 days after the completion of backfilling, the District may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the District.

### Jointings

Corrugated polyethylene drainage pipe shall be installed in accordance with the manufacturer's specifications and as specified herein. A pipe with physical imperfections shall not be installed. No more than 5 percent stretch in a section will be permitted.

## INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

After perforated pipe for subdrains has been laid, inspected, and approved, filter material shall be placed around and over the pipe to the depth indicated. Furnishing and construction of the sand filter material and compaction of filter material and the placement and compaction of overlying backfill material shall be in

accordance with the applicable provisions specified in Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION and in Section 205 EMBANKMENT FOR EARTH DAMS. Backfill and compaction requirements for the non-perforated subdrain pipe shall be in accordance with the applicable provisions specified in Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION.

## **TESTS**

### **PIPE TEST**

Strength tests of pipe shall conform to field service test requirements of the Federal Specification, ASTM specification, or AASHTO specification covering the product (paragraph PIPE FOR SUBDRAINS).

## **MEASUREMENT AND PAYMENT**

The length of pipe installed will be measured from end to end along the centerlines without any deduction for the diameter of the manholes or fittings. Pipe will be paid for according to the number of linear feet of subdrains placed in the accepted work. Payment for trench excavation, bedding and backfill, fittings and all other appurtenant work, except for the sand filter diaphragm, will be included in the payment for the pipe subdrain system.

**ITEM 605-1 - CORRUGATED POLYETHYLENE PIPE,  
PERFORATED, 6 INCH**

**ITEM 605-2 - CORRUGATED POLYETHYLENE PIPE, 6  
INCH**

## **SECTION 610 - WATER LINE CONSTRUCTION**

### **GENERAL**

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02510 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

Work within this section shall consist of relocating the 2 ½ inch service line, meter and pressure regulator near the school cafeteria.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |                 |   |
|-----------------|---|
| ASTM A 36/A 36M | (1996) Carbon Structural Steel  |
| ASTM A 53       | (1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- |               |   |
|---------------|---|
| ASME B1.20.1  | (1983; R 1992) Pipe Threads, General Purpose (Inch) |
| ASME B16.1    | (1989) Cast Iron Pipe Flanges and Flanged Fittings  |
| ASME B16.3    | (1992) Malleable Iron Threaded Fittings             |
| ASME B36.10 M | (1996) Welded and Seamless Wrought Steel Pipe       |

### AMERICAN WATER WORKS ASSOCIATION (AWWA)

- |                           |  |
|---------------------------|--|
| AWWA B300                 | (1992) Hypochlorites   |
| AWWA B301                 | (1992) Liquid Chlorine   |
| AWWA ANSI/AWWA C104/A21.4 | (1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA ANSI/AWWA C105/A21.5 | (1993) Polyethylene Encasement for Ductile-Iron Pipe Systems             |

AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75# mm through 1200# mm), for Water and Other Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA ANSI/AWWA C153/A21.53	(1994; Errata Nov 1996) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm) and 54 In. through 64 In. (1,400 mm through 1,600 mm) for Water Service Liquids
AWWA C200	(1991) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA ANSI/AWWA C205	(1995) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C509	(1994) Resilient-Seated Gate Valves for Water Supply Service
AWWA C510	(1997) Double Check Valve Backflow-Prevention Assembly
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA ANSI/AWWA C700	(1995) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA ANSI/AWWA C702	(1992) Cold-Water Meters - Compound Type
AWWA ANSI/AWWA C703	(1996) Cold-Water Meters - Fire Service Type
AWWA ANSI/AWWA C704	(1992) Propeller-Type Meters Waterworks Applications
AWWA C706	(1996) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA ANSI/AWWA C707	(1982; R 1992) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(1989) Underground Service Line Valves and Fittings

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

NFPA 1961

(1997) Fire Hose

NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 61

(1997a) Drinking Water System  
Components - Health Effects (Sections 1-9)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21

(1991) White or Colored Silicone Alkyd Paint

SSPC Paint 25

(1991) Red Iron Oxide, Zinc Oxide, Raw  
Linseed Oil and Alkyd Primer (Without Lead  
and Chromate Pigments)

**PIPING**

This section covers water supply, distribution, service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

**SERVICE LINES**

Piping for water service lines less than 3 inches in diameter shall be galvanized steel, or copper tubing, unless otherwise shown or specified. Piping for water service lines 3 inches and larger shall be ductile iron, or steel, unless otherwise shown or specified.

**DISTRIBUTION LINES 80 MM (3 INCHES) OR LARGER**

Piping for water distribution lines 3 inches or larger shall be ductile iron unless otherwise shown or specified.

**SUPPLY LINES 80 MM (3 INCHES) OR LARGER**

Piping for water supply lines 3 inches or larger shall be ductile iron, polyvinyl chloride (PVC) plastic, through 36 inch nominal diameter, Oriented PVC plastic

filament-wound reinforced or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe, steel, or reinforced concrete, unless otherwise shown or specified.

## SPRINKLER SUPPLY LINES

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 5 foot line.

## POTABLE WATER LINES

\*\*\*\*\*  
**NOTE: Incorporate this paragraph only if it is a requirement of the state where the project will be constructed.**  
\*\*\*\*\*

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF ANSI/NSF 61.

## EXCAVATION, TRENCHING, AND BACKFILLING

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION, except as modified herein.

## MANUFACTURER'S REPRESENTATIVE

The Contractor shall have a manufacturer's field representative present at the jobsite during the installation and testing of PE, RTRP, and/or RPMP pipe to provide technical assistance and to verify that the materials are being installed in accordance with the manufacturer's prescribed procedures. When the representative feels that the Contractor is installing and testing the PE, RTRP, and/or RPMP pipe in a satisfactory manner, certification shall be written to note which individuals employed by the Contractor are capable of properly installing the pipe. The field representative shall advise the Contractor of unsatisfactory conditions immediately when they occur. Such conditions include improper diameter of pipe ends, damaged interior liner, poorly prepared joints, improper curing of joints, moving pipe before joints are cured, bending pipe to follow abrupt changes in trench contours, leaving pipe ends open in trench overnight, not

properly drying joints after rain storms, exceeding effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction or any other condition which could have an adverse effect on the satisfactory completion and operation of the piping system.

## **SUBMITTALS**

Government approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 110 SUBMITTAL PROCEDURES:

SD-06 Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

SD-09 Reports

Bacteriological Disinfection; DA

Test results from commercial laboratory verifying disinfection.

SD-13 Certificates

Meters; DA

Manufacturer's certificate stating that each meter furnished has been tested for accuracy of registration and compliance with the accuracy and capacity requirements of the appropriate AWWA standard.

## **HANDLING**

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during

laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

## COATED AND WRAPPED STEEL PIPE

Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

## PRODUCTS

### PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

### DUCTILE-IRON PIPE

Ductile-iron pipe shall conform to AWWA ANSI/AWWA C151/A21.51, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA ANSI/AWWA C104/A21.4. Linings shall be standard. When installed underground, pipe shall be encased with 8 mil thick polyethylene in accordance with AWWA ANSI/AWWA C105/A21.5. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA ANSI/AWWA C115/A21.15.

### STEEL PIPE

Pipe 80 mm (3 Inches) and Larger, Not Galvanized

Steel pipe, not galvanized, shall conform to AWWA C200 with dimensional requirements as given in ASME B36.10M for pipe 6 inches in diameter and larger, and ASTM A 53 for smaller sizes. Pipe shall be welded or seamless with plain or shouldered and grooved ends in accordance with AWWA C606 for use with

mechanical couplings or bell-and-spigot ends with rubber gaskets. Bell-and-spigot ends for sizes less than 6 inches diameter shall be as required by AWWA C200. The minimum wall thickness of the various sizes of pipe shall be as follows:

Pipe Sizes	Thickness
------------	-----------



### Galvanized Steel Pipe

Galvanized steel pipe shall conform to ASTM A 53, standard weight.

### Protective Materials for Steel Pipe

Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of one of the following for the indicated pipe material and size:

a. Pipe and fittings less than 3 inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given 1 coat of coal-tar primer and 2 coats of coal-tar enamel conforming to AWWA C203; threaded ends of pipe and fittings shall be adequately protected prior to coating.

b. Pipe 3 Inches or Larger, Not Galvanized:

(1) Cement-mortar coating and lining shall conform to and shall be applied in conformance with AWWA ANSI/AWWA C205. Cement-mortar coating and linings shall not be used for pipe less than 4 inches in diameter.

(2) Coal-tar enamel lining, coating and wrapping shall conform to AWWA C203 for materials, method of application, tests and handling. Non-asbestos material shall be used for the outerwrap.

(3) Cement-mortar lining, in lieu of coal-tar enamel lining, may be used with coal-tar enamel coating and wrapping. Cement-mortar lining shall conform to and shall be applied in conformance with AWWA ANSI/AWWA C205.

### COPPER TUBING

Copper tubing shall conform to ASTM B 88, Type K, annealed.

## FITTINGS AND SPECIALS

### DUCTILE-IRON PIPE SYSTEM

Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA ANSI/AWWA C110/A21.10. Fittings and specials for use with push-on joint pipe shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4. Ductile iron compact fittings shall conform to AWWA ANSI/AWWA C153/A21.53.

### STEEL PIPE SYSTEM

#### Not Galvanized Steel Pipe

Fittings and specials shall be made of the same material as the pipe. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. Dimensions of steel pipe fittings shall be in accordance with AWWA ANSI/AWWA C208. The thickness and pressure rating of pipe fittings and specials shall be not less than the thickness specified and the pressure rating calculated for the pipe with which they are used. Protective materials for fittings and specials shall be as specified for the pipe. Specials and fittings that cannot be mechanically lined, coated, and wrapped shall be lined, coated, and wrapped by hand, using the same material used for the pipe with the same number of applications of each material, smoothly applied.

#### Galvanized Steel Piping

Steel fittings shall be galvanized. Screwed fittings shall conform to ASME B16.3. Flanged fittings shall conform to AWWA C207.

#### Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

## COPPER TUBING SYSTEM

Fittings and specials shall be flared and conform to ASME B16.26.

## JOINTS

### DUCTILE-IRON PIPE JOINTING

- a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA ANSI/AWWA C111/A21.11.
- b. Push-on joints shall conform to AWWA ANSI/AWWA C111/A21.11.
- c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA ANSI/AWWA C111/A21.11.

### STEEL PIPE JOINTING

#### Steel Pipe, Not Galvanized

- a. Mechanical couplings shall be as specified.
- b. Bell-and-spigot joints for use with rubber gaskets shall conform to AWWA C200, as appropriate for the type of pipe. Rubber gaskets shall conform to applicable requirements of AWWA C200.
- c. Flanges shall conform to AWWA C207, and shall be used only in above ground installation or where shown on the drawings, or when approved.

#### Mechanical Couplings

Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

## ISOLATION JOINTS

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

- a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.
- b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

## COPPER TUBING JOINTING

Joints shall be compression-pattern flared and shall be made with the specified fittings.

## VALVES

### CHECK VALVES

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure,

manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

## GATE VALVES

\*\*\*\*\*  
Note: Delete reference to AWWA C500 if resilient-seated gate valves are required.  
\*\*\*\*\*

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

## PRESSURE REDUCING VALVES

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for [ ] psi operating pressure on the inlet side, with outlet pressure set for [ ] psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be [threaded] [flanged]. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem

shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

#### **VACUUM AND AIR RELIEF VALVES**

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

#### **BACKFLOW PREVENTER VALVES**

Double check valve backflow preventers shall be of the same size as the service line and shall conform to AWWA C510-97.

#### **VALVE BOXES**

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

#### **VALVE PITS**

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with Section 505 CONCRETE STRUCTURES.

#### **MISCELLANEOUS ITEMS**

#### **SERVICE CLAMPS**

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

#### CORPORATION STOPS

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

#### GOOSENECKS

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

#### SERVICE STOPS

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

#### TAPPING SLEEVES

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

## SERVICE BOXES

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

## DISINFECTION

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

## METERS

Meters shall be the type and size shown on the drawings or specified. Meters of each of the various types furnished and installed shall be supplied by one manufacturer.

### Displacement Type

Displacement type meters shall conform to AWWA ANSI/AWWA C700. Registers shall be straight-reading and shall read in [U.S. gallons] [cubic feet]. Meters in sizes 1/2 through 1 inch [shall] [shall not] be frost-protection design. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be [a direct reading remote register designed in accordance with AWWA C706] [or] [an encoder type remote register designed in accordance with AWWA ANSI/AWWA C707]. Meters shall comply with the accuracy and capacity requirements of AWWA ANSI/AWWA C700.

### Turbine Type

NOTE: Turbine type main-line meters require a strainer.

Turbine type meters shall conform to AWWA C701 [Class I] [Class II]. The main casing shall be [bronze] [cast iron protected by corrosion resistant coating] with stainless steel external fasteners. Registers shall be straight-reading type, shall be [permanently sealed] [open] and shall read in [U.S. gallons] [cubic feet]. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be [a direct reading remote register designed in accordance with AWWA C706] [or] [an encoder type remote register designed in accordance with AWWA ANSI/AWWA C707]. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

### Compound Type

Compound type meters shall conform to AWWA ANSI/AWWA C702 and [shall] [shall not] be furnished with strainers. The main casing shall be [bronze] [cast iron protected by corrosion resistant coating] with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be [permanently sealed] [open] and shall read in [U.S. gallons] [cubic feet]. The meter [shall] [shall not] be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be [a direct reading remote register designed in accordance with AWWA C706] [or] [an encoder type remote register designed in accordance with AWWA ANSI/AWWA C707]. Meters shall comply with the accuracy and capacity requirements of AWWA ANSI/AWWA C702.

### Propeller Type

Propeller type meters shall conform to AWWA ANSI/AWWA C704. Registers shall be straight-reading type, shall be [permanently sealed] [open] and shall read in [U.S. gallons] [cubic feet]. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be [a direct-reading remote register designed in accordance with AWWA C706] [or] [an encoder-type remote register designed in accordance with AWWA ANSI/AWWA C707]. Meters shall comply with the accuracy and capacity requirements of AWWA ANSI/AWWA C703.

### METER BOXES

Meter boxes shall be of cast iron or concrete. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to

vehicular traffic, [shall use concrete covers with cast iron meter reader lids] [shall be concrete with cast iron lid and cast iron meter reader lid]. Plastic boxes and lids [shall] [shall not] be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

## METER VAULTS

\*\*\*\*\*  
Note: The designer shall provide construction details of meter vaults on the drawings.  
\*\*\*\*\*

Large meters shall be installed in reinforced concrete vaults in accordance with the details shown on the drawings.

## EXECUTION

## INSTALLATION

## CUTTING OF PIPE

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

## ADJACENT FACILITIES

\*\*\*\*\*  
NOTE: It will be the Contractor's responsibility to maintain the proper clearances between water lines and sewers. Where the water main is to be laid near the route of an existing sewer, force main, or inverted siphon, the in-place location of the sewer will be checked before laying the water main and, where necessary to provide minimum horizontal or vertical separation, will be shown on the contract drawings.  
\*\*\*\*\*

## Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

#### Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

#### Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

#### Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes.

#### Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

#### JOINT DEFLECTION

### Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

### Allowable for Steel Pipe

For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets shall be 5 degrees unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified.

### Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

### Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using

standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPA-01.

### Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

### Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

## JOINTING

### Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

### Not Galvanized Steel Pipe Requirements

- a. Mechanical Couplings: Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.
- b. Rubber Gaskets: Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the pipe manufacturer's recommendations.

### Galvanized Steel Pipe Requirements

Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

## Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

## Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

## Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

## INSTALLATION OF SERVICE LINES

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

### Service Lines 50 mm (2 Inches) and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch

connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size Inches	Corporation Stops, Inches For Ductile-Iron Pipe	Outlets w/Service Clamps, Inches Single & Double Strap
3	--	1
4	1	1
6	1-1/4	1-1/2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

NOTE:

- a. Service lines 1-1/2 inches and smaller shall have a service stop.
- b. Service lines 2 inches in size shall have a gate valve.

Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 3 inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

FIELD COATING AND LINING OF PIPE

## Steel Pipe 80 mm (3 In.) and Larger, Not Galvanized

a. Cement-mortar coating and lining: Field jointing shall conform to Appendix, AWWA ANSI/AWWA C205. Any defective area found in the coating and/or lining of pipe and joints shall be removed to the pipe wall and repaired. The repaired areas shall be at least equal in thickness to the minimum coating and/or lining required for the pipe. Steel reinforcement in the coating shall be repaired or replaced as necessary to assure a complete and soundly reinforced coating.

b. Coal-tar enamel coating, lining and wrapping: Field jointing shall conform to AWWA C203. The applied materials shall be tested by means of a spark-type electrical inspection device in accordance with the requirements of AWWA C203. Any flaws or holidays found in the coating and/or lining of pipe and joints shall be repaired by patching or other approved means. The repaired areas shall be at least equal in thickness to the minimum coating and/or lining required for the pipe.

## Galvanized Steel Pipe, Field Coating

NOTE: Field coating of joints for galvanized pipe will normally be required only when coating is specified for the pipe.

Field joints shall be given 1 coat of coal-tar primer and 2 coats of coal-tar enamel conforming to AWWA C203. The tests of the coating shall conform to AWWA C203, and any flaws or holidays found in the coating of pipe and joints shall be repaired by patching or other approved means; the repaired areas shall be at least equal in thickness to the minimum coating required for the pipe.

## SETTING OF METERS, VALVES AND VALVE BOXES

### Location of Meters

[Meters and meter boxes] [Vaults] shall be installed at the locations shown on the drawings. The meters shall be centered in the [boxes] [vaults] to allow for reading and ease of removal or maintenance.

### Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

#### Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

#### THRUST RESTRAINT

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

#### Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

## Restrained Joints

NOTE: When the restrained length is specified by the designer, this paragraph will be modified to delete the design requirement. The Government's designer should use TM 5-813-5 for guidance.

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

## HYDROSTATIC TESTS

NOTE: Test pressure for hydrostatic pressure and leakage tests will be the working pressure multiplied by 1.33. For a working pressure of 1.03 MPa (150 psi), the test pressure will be 1.38 MPa (200 psi). For other working pressures the test pressure will be adjusted accordingly.

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

## PRESSURE TEST

After the pipe is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of [200] [ ] psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of [200] [ ] psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION.

#### LEAKAGE TEST

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than [200] [REDACTED] psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to [200] [REDACTED] psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 0.5 \text{ power})$$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

#### TIME FOR MAKING TEST

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

## CONCURRENT HYDROSTATIC TESTS

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

- a. Pressure test and leakage test may be conducted concurrently.
- b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

## DISINFECTION

\*\*\*\*\*  
NOTE: The option of having the Contracting Officer perform the sampling and testing will be selected only if Government laboratory facilities are available and with concurrence from appropriate laboratory personnel. At some locations, either county or installation health officers inspect the disinfection process. If this is required add a notification requirement and give the office to be notified, with a phone number.  
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## BACTERIOLOGICAL DISINFECTION

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected [as prescribed by AWWA C651.] [as specified. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several

times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, [the Contracting Officer will take samples of water in proper sterilized containers for bacterial examination.] [personnel from the Contractor's commercial laboratory shall take at least 3] [ ] water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory shall be certified by the state's approving authority for examination of potable water.] The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

### LEAD RESIDUAL

Following the bacteriological disinfection and testing, the system shall be flushed with a sufficient velocity of water and sufficient tests performed at each hot and cold water discharge point until no more than 15 ppb lead residuals remain in the system. All tests and samples shall be performed in accordance with state and, if applicable, Federal regulations. Samples for testing are to be collected after a 6 hour continuous period of no flushing, and will be considered first draw samples. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. Lead residual test results shall be submitted to the Contracting Officer. The system will not be accepted until satisfactory bacteriological results and lead residual test results have been obtained. All flushing and testing for lead residuals, including all costs, are the responsibility of the Contractor.

### CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

### MEASUREMENT AND PAYMENT

No measurement shall be made.

Payment for the relocation of the meter, meter box, valves and valve boxes backflow preventer, service lateral and all appurtenant work as specified on the plans and in the specifications and as required by the water company shall be made at the contract lump sum price for the item below and this price shall

constitute full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work specified herein.

## ITEM 610-1 - RELOCATE 2 ½ INCH WATER SERVICE

### SECTION 618 - STORM DRAIN CONSTRUCTION

#### GENERAL

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
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#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 76	(1997) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
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ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
------------	---

ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
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ASTM C 828	(1990; R 1996) Low-Pressure Air Test of Vitrified Clay Pipe Lines
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ASTM C 1103	(1994) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
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ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

## **SUBMITTALS**

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110:

### **SD-06 Instructions**

Placing Pipe; FIO.

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

### **SD-13 Certificates**

Pipeline Testing; FIO. Hydrostatic Test on Watertight Joints; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed.

## **DELIVERY, STORAGE, AND HANDLING**

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris.

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

## **PRODUCTS**

### **PIPE FOR CULVERTS AND STORM DRAINS**

Reinforced concrete pipe shall be of the sizes indicated and shall conform to the requirements of ASTM C 76, Class IV.

## **MISCELLANEOUS MATERIALS**

### **CONCRETE**

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for Class "AA" concrete under Section 505 CONCRETE STRUCTURES. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752. Refer to Section 730 - EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS IN CONCRETE.

### **MORTAR**

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

## JOINTS

### Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

## EXECUTION

### EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for concrete pipe shall be in accordance with the applicable portions of Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION, Section 203 EARTHWORK and Section 205 EMBANKMENT FOR EARTH DAMS and the requirements specified below.

## TRENCHING

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 19 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

## BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

## CONCRETE PIPE REQUIREMENTS

Concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

## PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

## JOINTING

## Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

## BACKFILLING

### BACKFILLING PIPE IN TRENCHES

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below.

### BACKFILLING PIPE IN FILL SECTIONS

Pipe shall not be constructed in a fill section.

### MOVEMENT OF CONSTRUCTION MACHINERY

When compacting by rolling or operating heavy equipment over the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction

machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

## COMPACTION

Compaction and relative density testing shall be as specified in Section 205 EMBANKMENT FOR EARTH DAMS.

## MEASUREMENT AND PAYMENT

The length of pipe installed shall be measured along the centerlines of the pipe from end to end of pipe without deductions for diameter of manholes or length of fittings and structures. Pipe will be paid for at the contract unit price for the number of linear feet placed in the accepted work and shall be full compensation for all labor, material, tools and incidentals to construct the pipe complete in place..

### ITEM 618-1 - 24" RCP

### ITEM 618-2 - 60" RCP

Pipe plugs shall be paid for at the contract unit price for each pipe plug of each size and shall be full compensation for all labor, material, tools and incidentals to construct the plug complete in place.

### ITEM 618-3 - 24" PIPE PLUG, MAG 427

### ITEM 618-4 - 60" PIPE PLUG, MAG 427

Pipe encasement shall be Class "C" concrete and payment shall be per cubic yard of concrete as specified in Section 505 - CONCRETE STRUCTURES.

## SECTION 632 - FORCE MAINS

## GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-02532 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

### AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D (1994; Supple 1 Jun 1996; Supple 2 Dec 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3308 (1991a) PTFE Resin Skived Tape

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1 (1989) Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.3 (1992) Malleable Iron Threaded Fittings

### AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C105/A21.5 (1993) Polyethylene Encasement for Ductile-Iron Pipe Systems

AWWA ANSI/AWWA C110/A21.10 (1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA ANSI/AWWA C111/A21.11 (1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA ANSI/AWWA C115/A21.15 (1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

- AWWA ANSI/AWWA C151/A21.51 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
- AWWA C203 (1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
- AWWA C500 (1993) Metal-Seated Gate Valves for Water Supply Service
- AWWA C210 (1992) Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- AWWA C600 (1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

**DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)**

- DIPRA-01 (1997) Thrust Restraint Design for Ductile Iron Pipe

**MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)**

- MSS SP-78 (1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends

**SUBMITTALS**

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 110 SUBMITTAL PROCEDURES:

**SD-09 Reports**

Hydrostatic Tests; DA

Copies of test results.

**DELIVERY AND STORAGE**

Pipe, fittings and accessories, and pipe coatings shall not be damaged during delivery, handling, and storage.

## **PRODUCTS**

### **PIPE AND FITTINGS**

Piping for force mains shall be ductile iron. Pipe shall conform to the respective specifications and other requirements specified below.

#### **DUCTILE IRON PIPE**

Pipe shall conform to AWWA ANSI/AWWA C151/A21.51, working pressure not less than 150 psi, unless otherwise shown or specified.

Mechanical Fittings shall conform to AWWA ANSI/AWWA C110/A21.10, rated for 150 psi.

Push-On Fittings shall conform to AWWA ANSI/AWWA C110/A21.10 and AWWA ANSI/AWWA C111/A21.11, rated for 150 psi.

### **JOINTS**

Push-on Joints shall conform to AWWA ANSI/AWWA C111/A21.11.

Mechanical Joints shall conform to AWWA ANSI/AWWA C111/A21.11 as modified by AWWA ANSI/AWWA C151/A21.51.

Flanged Joints shall conform to AWWA ANSI/AWWA C115/A21.15.

### **VALVES**

#### **GATE VALVES**

Gate valves 3 inches and larger shall comply with AWWA C500. Valves for buried service shall be non-rising stem (NRS), 2 inch square nut operated with joints applicable to the pipe or installation. Buried valves shall be furnished with

extension stems comprising socket, extension stem and operating nut, and shall be of an appropriate length to bring operating nut to within 6 inches of grade. One 4 foot "T" handle valve wrench shall be furnished for each quantity of 6 buried valves. Gate valves that are exposed or installed inside shall be outside screw and yoke (OS&Y), handwheel operated with flange ends unless otherwise indicated. Gate valve operating nuts and handwheels shall have an arrow and the word "OPEN" cast in raised letters to indicate the direction of opening.

## VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subject to vehicular traffic. Cast iron boxes shall be the extension type with slide type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. The box length shall be adaptable, without full extension, to the depth of cover over the pipe at the valve locations. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "SEWER" shall be cast in the cover.

## MISCELLANEOUS MATERIALS

Miscellaneous materials shall comply with the following requirements:

### JOINT LUBRICANTS

Joint lubricants shall be as recommended by the pipe manufacturer.

### BOLTS, NUTS AND GLANDS

AWWA ANSI/AWWA C111/A21.11.

### JOINT COMPOUND

A stiff mixture of graphite and oil or inert filler and oil.

### JOINT TAPE

ASTM D 3308.

## EXECUTION

## INSTALLATION

Pipe, pipe fittings, and appurtenances shall be installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in Section 601, TRENCH EXCAVATION, BACKFILLING AND COMPACTION.

## CUTTING

Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practicable. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying.

## LAYING

Except where otherwise authorized, pipe shall be laid with bells facing the direction of laying. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with AWWA C600.

## JOINTING

Installation of mechanical and push-on type joints shall comply with AWWA C600 and the manufacturer's instructions. Installation of flanged joints shall comply with manufacturer's instructions.

## PE PIPE ENCASEMENT

When installed underground, pipe shall be encased with 8 mil thick polyethylene in accordance with AWWA ANSI/AWWA C105/A21.5.

## INSTALLATION OF VALVES

Prior to installation, valves shall be cleaned of all foreign matter and inspected for damage. Valves shall be fully opened and closed to ensure that all parts are properly operating. Valves shall be installed with the stem in the vertical position.

## INSTALLATION OF VALVE BOXES

Valve boxes shall be installed over each outside gate valve, unless otherwise indicated. Valve boxes shall be centered over the valve. Fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides or to undisturbed trench face, if less than 4 feet.

## THRUST RESTRAINT

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, shall be provided with thrust restraint. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

### Thrust Blocks

Thrust blocking shall be Class B concrete as specified in Section 505 - CONCRETE STRUCTURES. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

### Restrained Joints

For ductile iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

## HYDROSTATIC TESTS

The pipeline shall be subjected to both a pressure test and a leakage test. Testing shall be the responsibility of the Contractor. The test must be witnessed by the Engineer. The Engineer shall be notified at least 7 days in advance of equipment tests. The final test report shall be delivered to the Engineer within 7 days of the test.

#### PRESSURE TEST

After the pipe has been installed, joints completed, thrust blocks have been in place for at least five days, and the trench has been partially backfilled, leaving the joints exposed for examination, the pipe shall be filled with water to expel all air. The pipeline shall be subjected to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Each valve shall be opened and closed several times during the test. The exposed pipe, joints, fitting, and valves shall be examined for leaks. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve shall be replaced.

#### LEAKAGE TEST

The maximum leakage permitted shall not exceed 25 U.S. gallons per inch nominal diameter per mile of pipe per day, based on a pressure of 100 psi. Allowable leakage at other test pressures will be the above limit multiplied by the product of the square root of the test pressure divided by 10.

The leakage test may be conducted subsequent to or concurrently with the pressure test. The amount of water permitted as leakage for the line shall be placed in a sealed container attached to the supply side of the test pump. No other source of supply will be permitted to be applied to the pump or line under test. The water shall be pumped into the line by the test pump as required to maintain the specified test pressure as described for pressure test for a 2 hour period. Exhaustion of the supply or the inability to maintain the required pressure will be considered test failure. At the conclusion of the test, the amount of water remaining in the container shall be measured and the results recorded in the test report.

#### RETESTING

If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted until the results of the tests are within specified allowances, without additional cost to the District.

## **MEASUREMENT AND PAYMENT**

Measurement of all pipe shall be of the linear feet of pipe installed, measured along the centerline of the pipe, through all valves and fittings, from the centerline of the fittings or centerline of valves on ends of pipe to the centerline of fittings, centerline of valves on ends of pipe or to the end of pipe, as the case may be, for all through runs of pipe. Measurement shall be to the nearest 1 foot. Payment will be made at the unit price bid per linear foot of each type and size of pipe called for in the proposal. Such payment shall be full compensation for furnishing and installing the pipe and fittings, specials, adapters, thrust restraint, etc., complete in place, as called for on the plans and/or on the standard details, and shall include all costs of excavation, removal of obstructions, shoring and bracing, bedding, backfilling, compaction, maintenance of traffic, demolition, pavement replacement, curb and gutter replacement, sidewalk replacement, landscape restoration, testing, connections to existing lines or works, and all work required herein and not specifically covered in other pay items.

### **ITEM 632-1 - 12" DUCTILE IRON PIPE**

Concrete thrust blocks and anchors shall be measured by the cubic yards 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 yard, and shall be compensation in full for excavation, formwork, placing and finishing concrete, reinforcing, backfilling and compaction, and all work not specifically covered in other pay items.

### **ITEM 632-2 - THRUST BLOCKS**

Payment for furnishing and installing gate valves and valve boxes will be made at the respective contract unit price each for such items complete in place. Payment will include the furnishing of all testing, plant, labor, material and incidentals necessary to complete the work, as specified and as shown.

### **ITEM 632-3 - 12" GATE VALVE**

### **ITEM 632-4 - VALVE BOX PER MAG 391-2**

## SECTION 727 - STEEL REINFORCEMENT

### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-03200 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### ACI INTERNATIONAL (ACI)

- |              |   |
|--------------|---|
| ACI 318/318R | (1995) Building Code Requirements for Structural Concrete and Commentary          |
| ACI 318M     | (1995) Building Code Requirements for Structural Concrete and Commentary (Metric) |

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |                   |  |
|-------------------|--|
| ASTM A 53         | (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 82         | (1995a) Steel Wire, Plain, for Concrete Reinforcement                      |
| ASTM A 184/A 184M | (1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement       |
| ASTM A 185        | (1994) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement         |
| ASTM A 496        | (1995a) Steel Wire, Deformed, for Concrete Reinforcement                   |
| ASTM A 497        | (1995) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement      |

ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(1995b) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(1995) Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A 775/A 775M	(1996) Epoxy-Coated Reinforcement Steel Bars
ASTM A 884/A 884M	(1996a) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM C 1116	(1995) Fiber-Reinforced Concrete and Shotcrete

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel
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CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1	(1996) Manual of Standard Practice
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**SUBMITTALS**

District approval is required for submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110:

SD-04 Drawings

Concrete Reinforcement System; DA

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-13 Certificates

Reinforcing Steel; DA

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

## **DELIVERY AND STORAGE**

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

## **PRODUCTS**

### **DOWELS**

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

### **FABRICATED BAR MATS**

Fabricated bar mats shall conform to ASTM A 184/A 184M.

### **REINFORCING STEEL**

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. In highly corrosive environments or when directed by the Engineer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

### **WELDED WIRE FABRIC**

Welded wire fabric shall conform to ASTM A 497. When directed by the Engineer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

## **WIRE TIES**

Wire ties shall be 16 gauge or heavier black annealed steel wire.

## **SUPPORTS**

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

## **EXECUTION**

## **REINFORCEMENT**

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

## **PLACEMENT**

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars

required to meet structural requirements, shall be approved before concrete is placed.

## **SPLICING**

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

## **WELDED-WIRE FABRIC PLACEMENT**

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports as specified above.

## **DOWEL INSTALLATION**

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

## **MEASUREMENT AND PAYMENT**

No measurement of reinforcing steel will be made. All costs for furnishing and installing steel reinforcement for concrete shall be included in the unit price for the concrete or concrete structures.

## SECTION 730 - EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS IN CONCRETE

### GENERAL

*This specification is adopted from Department of the Army, U.S. Army Corps of Engineers CEGS-03151 and modified. All references within this specification to the "Government" shall mean to the Flood Control District of Maricopa County or the district's authorized representative.*

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 109	(1993) Steel, Strip, Carbon, Cold-Rolled
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 570/A 570M	(1995) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 152	(1994) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2628 (1991) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

ASTM D 2835 (1989; R 1993) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

#### ASME INTERNATIONAL (ASME)

ASME BPV IX (1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

#### CORPS OF ENGINEERS (COE)

COE CRD-C 513 (1974) Corps of Engineers Specifications for Rubber Waterstops

COE CRD-C 572 (1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

### **SUBMITTALS**

District approval is required for all submittals with a "DA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with the submittal procedures in Section 110:

#### SD-08 Statements

Splicing Waterstops; DA.

Procedures for splicing waterstops shall be submitted.

#### SD-09 Reports

Premolded Expansion Joint Filler Strips; FIO. Compression Seals and Lubricant; FIO. Metallic Waterstops; FIO.

Certified manufacturer's test reports shall be provided for premolded expansion joint filler strips, compression seals and lubricant, and metallic waterstops to verify compliance with applicable specification.

#### SD-14 Samples

Field Molded Sealants and Primer; FIO.

One gallon of field-molded sealant and one quart of primer (when primer is recommended by the sealant manufacturer) shall be provided for testing.

Waterstops; FIO.

Waterstop materials and splice samples shall be submitted for inspection and testing and shall be identified to indicate manufacturer, type of material, size and quantity of material and shipment represented. Each materials sample shall be a piece not less than 12 inches long cut from each 200 feet of finished waterstop furnished, but not less than a total of four linear feet of each type and size furnished. For spliced segments of waterstops to be installed in the work, one spliced sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site shall be furnished for inspection and testing. The spliced samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each spliced sample shall be not less than 12 inches long.

## **PRODUCTS**

### **MATERIALS**

#### **PREMOLDED EXPANSION JOINT FILLER STRIPS**

Premolded expansion joint filler strips shall conform to ASTM D 1751 or ASTM D 1752, Type I, or resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

#### **JOINT SEALS AND SEALANTS**

##### **Field Molded Sealants and Primer**

Field molded sealants and primer shall conform to ASTM C 920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, nonshrink, nonreactive with sealant, and nonabsorptive material type such as extruded butyl or polychloroprene foam rubber.

## Compression Seals and Lubricant

Compression seals shall conform to ASTM D 2628; lubricant for installation shall conform to ASTM D 2835.

## WATERSTOPS

### Non-Metallic Waterstops

Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572.

### Metallic Waterstops

a. Flexible Metal Waterstops - Copper waterstops shall conform to ASTM B 152, temper soft annealed, 20 oz weight sheet. Stainless steel waterstops shall conform to ASTM A 167, Type 304L, No. 1 Finish or equivalent, annealed, 0.0375 inch (20 Gage) strip.

b. Flat Steel Waterstops - Flat steel waterstops shall conform to ASTM A 109, temper No. 2, No. 2 edge, No. 1 Finish or ASTM A 570/A 570M, Grade D.

## TESTS, INSPECTIONS, AND VERIFICATIONS

### MATERIALS TESTS

#### Field-Molded Sealants

Samples of sealant and primer, when use of primer is recommended by the manufacturer, as required in paragraph FIELD MOLDED SEALANTS AND PRIMER, shall be tested by and at the expense of the District for compliance with paragraph FIELD MOLDED SEALANTS AND PRIMER. If the sample fails to meet specification requirements, new samples shall be provided and the cost of retesting shall be born by the Contractor.

## Non-Metallic Waterstops

Samples of materials and splices as required in paragraph WATERSTOPS shall be visually inspected and tested by and at the expense of the District for compliance with COE CRD-C 513 or COE CRD-C 572 as applicable. If a sample fails to meet the specification requirements, new samples shall be provided and the cost of retesting will be born by the Contractor.

## **SPLICING WATERSTOPS**

### Procedure and Performance Qualifications

Procedure and performance qualifications for splicing waterstops shall be demonstrated in the presence of the Engineer.

### Non-Metallic Waterstops

Procedure and performance qualifications for splicing non-metallic waterstops shall be demonstrated by the manufacturer at the factory and the Contractor at the job site by each making three spliced samples of each size and type of finished waterstop.

### Metal Waterstops

Procedure and performance qualifications for splicing metal waterstops shall be demonstrated at the job site by the Contractor. The brazing procedure, brazers and brazing operators for splicing copper waterstops shall be qualified in accordance with Part QB (Brazing), Article XI (Brazing, General Requirements), paragraph QB-170 (Peel Tests) and other applicable requirements of Articles XI, XII, and XIII of ASME BPV IX. The welding procedure and welders for splicing stainless steel waterstops shall be qualified in accordance with the manufacturer's recommendations.

## **EXECUTION**

## **INSTALLATION**

Joint locations and details, including materials and methods of installation of joint fillers and waterstops, shall be as specified, as shown, and as directed. In no case shall any fixed metal be continuous through an expansion or contraction joint.

## EXPANSION JOINTS

Premolded filler strips shall have oiled wood strips secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces. The wood strips shall be slightly tapered, dressed and of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant or seals to the size shown. Material used to secure premolded fillers and wood strips to concrete shall not harm the concrete and shall be compatible with the joint sealant or seals. The wood strips shall not be removed until after the concrete curing period. The groove shall be thoroughly cleaned of all laitance, curing compound, foreign materials, protrusions of hardened concrete and any dust which shall be blown out of the groove with oil-free compressed air.

### Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degrees F. Immediately prior to installation of field molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents or other means as recommended by the sealant manufacturer. The joints shall be dry prior to filling with sealant. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

### Joints With Preformed Compression Seals

The joint seals shall be installed with equipment which shall be capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal and with no more than five percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant, and the seal shall be installed to the depth indicated with joint installation equipment. Butt joints shall be coated with liberal applications of lubricant.

## CONTRACTION JOINTS

Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Waterstops shall be protected during application of bond breaking material to prevent them from being coated.

## WATERSTOPS

Waterstops shall be carefully and correctly positioned during installation to eliminate faulty installation that may result in joint leakage. The bottom of each waterstop shall be embedded a minimum of 150 mm \~ 6 inches in firm rock or sealed to other cut-off systems. All waterstops shall be installed so as to form a continuous watertight diaphragm in each joint. Adequate provision shall be made to support and protect the waterstops during the progress of work. Any waterstop punctured or damaged shall be replaced or repaired at the Contractor's expense. The concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

## Splices

Joints in waterstops shall be spliced together by qualified splicers using the approved splicing procedures to form a continuous watertight diaphragm. Splices shall be as followed:

- a. Non-Metallic Waterstops - All splices shall be made on a bench in a temporary shop provided at the site of the installation or at the manufacturer's plant. A miter guide and portable power saw shall be used to cut the ends to be joined to insure good alignment and contact between joined surfaces. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions and the like) shall be maintained across the splice.
- b. Rubber Waterstops - Splices shall be vulcanized in accordance with the approved procedure.
- c. Polyvinylchloride Waterstops - Splices shall be made by heat sealing the adjacent surfaces in accordance with the approved procedure. A thermostatically controlled electrical heat source shall be used to make all splices. The correct temperature at which splices should be made will differ with the material concerned but the applied heat should be sufficient to melt but not char the plastic. Waterstops shall be reformed at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop.

The spliced area, when cooled and bent by hand in as sharp an angle as possible, shall show no sign of separation.

d. Flexible Metal Waterstop - Splices in copper shall be lap joints made by the approved brazing procedure. Splices in stainless steel shall be made by the approved welding procedure. Damaged waterstops shall be repaired by removing damaged portions and patching. Patches shall overlap a minimum of 1 inch onto undamaged portion of the waterstop.

e. Flat Steel Waterstops - Splices shall be welded.

## **MEASUREMENT AND PAYMENT**

No separate measurement will be made for expansion and contraction joints which are included in the costs for the items to which work for expansion and contraction joints are incidental.

Furnishing and installing waterstops shall be considered incidental to the construction of the concrete structures. No separate payment will be made for expansion and contraction joints which are included in the costs for the items to which work for expansion and contraction joints are incidental.