

## Summary of Administrative Revisions to Standard Specifications 600 Series

Section	Description of Revision
<b>ALL</b>	<ul style="list-style-type: none"> <li>• Formatting in accordance with CSI standards               <ul style="list-style-type: none"> <li>○ All Paragraphs identified by a letter                   <ul style="list-style-type: none"> <li>▪ Sub-paragraphs identified by a number</li> </ul> </li> </ul> </li> <li>• Replace pronouns with appropriate noun references</li> <li>• Delete number word references and retain numeric number only</li> <li>• Modify grammar structure for clarity</li> <li>• Edit cross-references</li> <li>• Delete references to self (Uniform Standard Specifications)</li> <li>• Delete metric units</li> <li>• Delete references to design and procedural guidelines</li> <li>• Delete references to codes and standards that do not specifically relate to the section</li> </ul>
<b>604</b>	<ul style="list-style-type: none"> <li>• Subsection 604.04.01 – Added measurement item for Pipe, and moved payment language to subsection 05</li> </ul>
<b>605</b>	<ul style="list-style-type: none"> <li>• Subsection 605.04.01 – Added measurement item for End Section</li> <li>• Subsection 605.05.01 – Added payment item for End Section</li> </ul>
<b>610</b>	<ul style="list-style-type: none"> <li>• Subsection 610.02.04 – Modified Riprap Table – added gradations.</li> </ul>

## SECTION 601

## PIPE CULVERTS – GENERAL

~~01~~DESCRIPTION

## 601.01.01 GENERAL

- A. This ~~ese specifications~~ section includes s general requirements that are applicable to all types of culvert pipes ~~irrespective to~~ regardless of the material or culvert use with the following exceptions:
1. ~~1.~~ Structural plate pipe,
  2. ~~2.~~ Water distribution systems and sanitary sewer system specifications will specify the pipe to be used in their respective installations.
- B. This work shall consist of furnishing and installing pipe culverts, siphons, end sections, end walls, ~~etc.~~ and so forth, as may be required to complete the work shown on the plans or established by the Engineer.
- C. The pipe shall comply with AASHTO Design and Construction LRFD Specifications most current edition and these specifications. The more stringent requirements shall apply.

~~REFERENCE CODES AND STANDARDS:~~

- ~~(a) Uniform Standard Specifications for Public Works' Construction Off-Site Improvements, Clark County Area, Nevada that will henceforth be referred to as "USS" Specifications and Drawings.~~
- ~~(b) Contract Special Provisions and Drawings.~~
- ~~(c) NRS 338.176, NAC 625.550.~~
- ~~(d) Most current ASTM, AASHTO, or NDOT test procedures.~~
- ~~(e) Related Interagency Quality Assurance Committee (IQAC) procedures at: [www.accessclarkcounty.com/depts/public\\_works/Pages/iqac.aspx](http://www.accessclarkcounty.com/depts/public_works/Pages/iqac.aspx)~~

~~02~~MATERIALS

## 601.02.01 GENERAL

- A. The materials used ~~shall be those prescribed or used for the several items which constitute the finished work and~~ shall conform to the requirements in the following subsections:

~~Table 1– List of Pipe Types~~

<del>Materials</del> <u>s</u> <del>Type</del>	<del>Section</del> <u>/-or</u> <del>Subsection</del>
Bituminous Coated Corrugated Metal Pipe and Pipe Arches	709.03.02
Clay Pipe	708.03.04
Corrugated Aluminum Pipe	709.03.0 <del>5</del> <u>4</u>
Corrugated Metal Pipe and Pipe Arches	709.03.01
Grout and Mortar Sand	706.03.04
Nonreinforced Concrete Pipe	708.03.02
Portland Cement	701
Reinforced Concrete Pipe	708.03.01

Materials <del>Type</del>	Section <del>or</del> Subsection
Rubber Gaskets	707.03.0 <del>261</del>
Thermoplastic Pipe	709.03. <del>109</del>

- B. When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods.
1. Material samples will be obtained for laboratory testing for compliance ~~for~~with materials quality requirements as specified in the referenced specifications.
  2. This can be the basis for acceptance of manufacturing lots.
- C. All materials will be subject to inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.
- D. The lengths shown on the plans are approximate.
- E. For structural plate pipe and arches, ~~attention is directed to~~comply with Section 606, "Structural Plate Pipe, ~~Pipe Arch~~, and Pipe Arch Culverts."

### ~~03~~CONSTRUCTION

#### 601.03.01 EARTHWORK

- A. Excavation and backfill shall conform to the requirements of Section 206, "Structure Excavation," and Section 207, "Structure Backfill," or Section 208, "Trench Excavation and Backfill," when the culvert is placed in a trench.
1. The pipe shall be bedded as shown in the standard specifications and/or drawings appended to the plans or as specified in the Special Provisions.
  2. When no bedding class is specified, the requirements for normal bedding as shown in the Uniform Standard Drawings shall apply.
  3. The lines and grades will be established by the Engineer or as designated in the contract ~~provisions~~documents.
- B. Where pipes are to be installed in new embankments on a steep slope or in a difficult location, the height of new embankments may be varied as directed by the Engineer before installing pipes.
- C. When headwalls are not required and granular materials are used for backfilling, the fill at the ends of the structure shall be sealed against the infiltration of water by bedding the ends of the structure using ~~e~~Class II CLSM or concrete.

#### 601.03.02 HEADWALLS

- A. Where shown on the plans, inlet and outlet headwalls shall be constructed or installed in connection with culvert pipes.
- B. Where ~~such~~ headwalls are constructed or installed, the ends of pipes shall be placed flush or cut off flush with the headwall face, unless otherwise permitted by the Engineer.
- C. Headwalls ~~are to~~shall be constructed to conform to ~~the applicable requirements of~~ Sections ~~s~~ 501, "Portland Cement Concrete" and Section 502, "Concrete Structures."

**601.03.03 END SECTIONS**

- A. The bed for the end section shall be excavated to the required width and grade.
- B. For metal end sections with toe plates, a trench shall be excavated for the toe plate in a manner to permit the toe plate from being against the inner face of the trench when the end section is in its final position. After end sections have been properly secured to the pipe, this trench shall be backfilled and firmly compacted.
- C. Precast concrete end section shall be placed with its tongue (or groove) fully entered in the groove (or tongue) of the pipe.
- D. Thermoplastic pipe greater than 30 inches" shall not be used at the open-end sections.

**601.03.04 JACKED PIPES**

- A. Culvert pipe to be jacked in place between the limits shown on the plans shall conform to the requirements of the respective section of pipe culverts.
- B. The strength of pipe or gauge of pipe will be determined for vertical load only in embankment conditions. Any additional reinforcement or strength required to withstand jacking pressure shall be determined and furnished by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.
- C. Variation from theoretical alignment and grade at the time of completion of placing shall not exceed 0.2 foot ~~(6.1 centimeters)~~ for each 20 feet ~~(6.1 meters)~~ of pipe placed.
- D. The diameter of the excavated hole shall not be more than 0.1 foot ~~(3 centimeters)~~ greater than the outside diameter of the pipe.
  - 1. Sluicing and jetting with water will not be permitted.
  - 2. When the material tends to cave in from outside these limits, a shield shall be used ahead of the first section of pipe or the face of excavation shall not extend beyond the end of the pipe greater than 1-1/2 feet ~~(0.46 meters)~~ unless permitted by the Engineer.
- E. Areas resulting from caving or excavating outside the above limits shall be backfilled with sand or grout by a method, ~~which~~ that will fill the voids.

**601.03.05 LAYING CULVERT PIPE**

- A. Laying of culvert pipe shall conform to the requirements of the respective sections of culvert pipe.

**601.03.06 EXTENDING EXISTING CULVERTS**

- A. Where shown on the plans or directed by the Engineer, existing culverts shall be extended in accordance with the provisions for installing new culverts and the following additional provisions.
- B. Existing headwalls shall be demolished and removed and disposed of or moved to the extended location as indicated on the plans or ordered by the Engineer. ~~Attention is directed to~~ Comply with Section 202, "Removal of Structures and Obstructions."
- C. A headwall that is not to be reset shall be demolished without injury to the existing culvert and removed and disposed of in accordance with the provisions of Section 202, "Removal of Structures and Obstructions." If shown on the plans or ordered by the Engineer, a new concrete headwall shall be constructed in accordance with the provisions of Section 501,

"Portland Cement Concrete." of these specifications or a flared end section shall be attached thereto.

#### 601.03.07 VIDEO INSPECTION

- A. Unless otherwise approved by the ~~entity~~Contracting Agency, all video inspection shall be completed by a National Association of Sewer Service Companies (NASSCO) certified operator, certified at the user level minimum.
  - 1. The user ~~must~~shall have completed the Pipeline Assessment and Certificate Program (PACP).
  - 2. Video inspection reports must follow the NASSCO format and use standard sewer defect codes.

### ~~04~~METHOD OF MEASUREMENT

#### 601.04.01 MEASUREMENT

- A. The materials to be paid for under these specifications will be listed in the contract items by size, class, type, gauge, or whatever information is necessary for identification.
- B. The quantity of culvert pipe to be measured for payment will be the actual number of linear feet ~~(meters)~~ of pipe including the stub on end sections, complete and in place. When pipes are cut to fit a structure or slope, the quantity to be paid for will be the length of pipe necessary to be placed before cutting, measured in even 2-foot ~~(61-centimeters)~~ increments.
- C. Culvert pipe bends, wyes, tees, and other branches will be measured and paid for by the linear foot ~~(meter)~~ for the sizes of pipes involved. Wyes, tees, eccentric reducers, and other branches will be measured along centerlines to the point of intersection.
- D. Structure excavation and structure backfill, Portland cement concrete, and reinforcement required for headwalls, end walls, structures, and other items of work required by the plans and ~~s~~Special provisions to complete the work, will be measured and paid for as separate items as provided for under their respective sections of these specifications, or the contract documents. Structure excavation and backfill will not be measured for payment on preformed end sections.
- E. No separate measurement or payment will be made for constructing jacking pits and backfilling all pits after the pipe is jacked, or for excavation and backfill between the limits shown on the plans for jacking the pipe. Full compensation therefore ~~e~~ will be considered as included in the price paid for jacked pipe.
- F. Culvert pipe to be placed outside the limits for jacked pipe shall conform to the requirements of the respective section of pipe culverts. The limits for payment of structure excavation and backfill will be the original ground line before jacking pits are excavated.
- G. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

### ~~05~~BASIS OF PAYMENT

#### 601.05.01 PAYMENT

- A. The accepted quantities of culvert pipe measured as specified in Subsection 601.04.01, "Measurement," will be listed under the respective sections of pipe culverts.

## PIPE CULVERTS – GENERAL

601

- B. When any of the various sizes, types, and gauges of pipe is installed by the jacking method, the contract price paid per linear foot ~~(meter)~~ for jacked pipe shall include full compensation for furnishing the pipe, excavating, jacking, furnishing and placing backfill material, and all incidentals and for doing all the work involved in jacking the pipe, as specified.
- C. Full compensation for furnishing pipe with end finish, including distortion if required, will be considered as included in the price paid per linear foot ~~(meter)~~ for the pipe involved and no additional compensation will be allowed therefore. Full compensation for bedding will be considered included in the price paid per cubic yard ~~(cubic meter)~~ for backfill or granular backfill as the case may be and such payment shall include compensation for all the materials, labor, tools, and incidentals necessary to complete the work.
- D. Provisions for handling of whatever water may be encountered at the site shall be an obligation of the Contractor, and payment therefore shall be considered as subsidiary to the items involved, and no further compensation will be allowed therefore.
- E. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

**SECTION 602****NON-REINFORCED CONCRETE AND CLAY PIPE****01 DESCRIPTION****602.01.01 GENERAL**

- A. This work shall consist of furnishing and installing non-reinforced concrete pipe or clay culvert pipe of the kind, sizes, and dimensions shown on the plans or established by the Engineer and in accordance with ~~the requirements of~~ these specifications.

**02 MATERIALS****602.02.01 GENERAL**

- A. Materials and their use shall conform to the applicable requirements of Subsection ~~603.02.01, "General," of Section 603, "Reinforced Concrete Pipe"~~ and Subsection ~~601.02.01, "General," of Section 601, "Pipe Culverts - General."~~

**03 CONSTRUCTION****602.03.01 GENERAL**

- A. The construction requirements shall be as prescribed in Subsection ~~603.03.01, "General,"~~ through Subsection 603.03.06, "Junctions," ~~of Section 603, "Reinforced Concrete Pipe,"~~ with the ~~following~~ modifications specified below:
- B. ~~(a)~~ External bands of Class "C" mortar as designated in Subsection ~~501.03.14, "Mortar,"~~ may be placed around the pipe joints as herein specified.
1. Several sections of pipe shall be joined before commencing banding operations, but the placing of external bands shall never be more than ~~five (5)~~ lengths of pipe behind joining operations.
  2. Immediately in advance of placing external band mortar, the external surface of the pipe sections at the joints shall be thoroughly cleaned and wetted to ensure proper bonding of the band mortar with the pipe.
  3. Care shall be exercised to make a union between the band and the mortar ~~which~~ that was placed under the joint before the pipe sections were abutted.
  4. The band shall not be less than ~~three-eighths (3/8) inch (0.95 centimeters)~~ thick at the pipe joint and shall be approximately ~~four (4) inches (10 centimeters)~~ wide, overlapping the abutting ends of the pipe sections approximately ~~two (2) inches (5 centimeters)~~.
  5. The edges of the band shall adhere to the pipe surface to prevent peeling and shall be finished in a workmanlike manner.
  6. Rubber gaskets may be used to join the pipe.
  7. Rubber gaskets shall conform to the requirements of Subsection ~~707.03.02, "Rubber Gaskets."~~
- C. ~~(b)~~ When irrigation or sewer pipe is placed beyond the limits of roadway excavation or embankment, the initial covering of backfill material shall be fine earth or sand approved

602

## NON-REINFORCED CONCRETE AND CLAY PIPE

by the Engineer. Placing the remainder of the trench backfill in layers and compacting to a relative compaction of ~~ninety (90\_)~~ percent will not be required.

- D. ~~(e)~~—Openings shall be cut into irrigation or sewer pipe and connections made thereto as shown on the plans or directed by the Engineer.
1. Openings shall be cut to proper sizes.
  2. Connections shall be cut to fit closely and shall be strongly cemented to the pipe with banding mortar.
  3. In all cases, the area of pipe where the connection is made shall be clean and wet when the mortar is applied.

~~04~~METHOD OF MEASUREMENT**602.04.01 MEASUREMENT**

- A. Method of measurement shall conform to the requirements of Subsection 601.04.01, "Measurement," with the exception that backfill will not be measured for payment when placed beyond the limits of roadway excavation or embankment.

~~05~~BASIS OF PAYMENT**602.05.01 PAYMENT**

- A. Payment shall conform to the requirements of Subsection 601.05.01, "Payment," and ~~in addition thereto, the following requirements shall apply~~this subsection.
- B. The accepted quantities of non-reinforced concrete or clay pipe will be paid for at the contract bid price per linear foot ~~(meter)~~ for the types and sizes specified.
- C. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- D. Payment will be made under:

**PAY ITEM****PAY UNIT**

(Size) Non-reinforced Concrete Pipe (type) .....	Linear Foot <del>(Meter)</del>
(Size) Clay Pipe (type) .....	Linear Foot <del>(Meter)</del>



## SECTION 603

## REINFORCED CONCRETE PIPE

~~01~~DESCRIPTION

## 603.01.01 GENERAL

- A. This work shall consist of furnishing circular or elliptical, reinforced concrete pipe, siphons, and conduits of the size, classes, and dimensions and at locations shown on the plans or established by the Engineer and in accordance with ~~the requirements of~~ ASTM C76, ASTM C655, or ASTM C507, with design basis in accordance with Section 708, "Concrete and Clay Pipe and Drains," and where indicated in these specifications.
- B. The installation shall conform to the ~~requirements of~~ AASHTO LRFD Bridge Construction Specifications and ~~where indicated in~~ these specifications.

~~REFERENCE CODES AND STANDARDS:~~

- ~~(a) Uniform Standard Specifications for Public Works' Construction Off-site Improvements, Clark County Area, Nevada that will henceforth be referred to as "USS" Specifications and Drawings.~~
- ~~(b) Contract Special Provisions and Drawings.~~
- ~~(c) NRS 338.176, NAC 625.550.~~
- ~~(d) Most current ASTM, AASHTO, ACI or NDOT test & inspection procedures.~~
- ~~(e) Related Interagency Quality Assurance Committee (IQAC) procedures at: [www.accessclarkcounty.com/depts/public\\_works/Pages/igac.aspx](http://www.accessclarkcounty.com/depts/public_works/Pages/igac.aspx)~~

~~02~~MATERIAL

## 603.02.01 GENERAL

- A. Materials and their use shall conform to ~~the applicable requirements of~~ Subsection 601.02.01, ~~of Section 601, "Pipe Culverts -- General," and in addition thereto,~~ the ~~following~~ requirements below ~~shall apply~~.
- B. Prior to the use of these materials, the Contractor shall submit to the Engineer for approval a document certifying that the material meets these specifications and Section 708, "Concrete and Clay Pipe and Drains," from an authorized source approved by the Interagency Quality Assurance Committee (IQAC).
- C. Flared end sections (precast) shall conform to the details and dimensions shown on the plans and, except for shape, shall conform to the material requirements of this section for reinforced concrete pipe.
- D. Rubber gaskets are required for all circular pipes and mastic for elliptical, ~~and Rubber gaskets~~ shall conform to ~~the requirements of~~ Subsection 707.03.06~~4~~, "Rubber Gaskets."
- E. If ~~joint~~ mortar is required, it shall be as specified in Subsection 501.03.41~~12~~, "Mortar," Class "C":
  - 1. Sand shall conform to ~~the requirements of~~ Subsection 706.03.04, "Grout and Mortar Sand," ~~of these specifications.~~
  - 2. The materials shall be mixed to a consistency suitable for the purpose intended.
  - 3. All mortar shall be used within 30 minutes after the mixing water has been added.

603

## REINFORCED CONCRETE PIPE

4. Admixtures of hydrated lime, fire clay, diatomaceous earth, or other approved inert material may be used in the mortar to facilitate workability if the Contractor elects.
5. The amount of admixture to be added shall be the quantity determined by the Engineer.

**03 CONSTRUCTION****603.03.01 GENERAL**

- A. Construction methods shall conform to ~~the requirements of~~ Subsections 601.03.01, "General Earthwork," through Subsection 601.03.06, "Extending Existing Culverts Junctions," of Section 601, ~~"Pipe Culverts - General"~~ and ~~in addition thereto,~~ shall meet the ~~following~~ requirements below. All pipe installations shall conform to the workmanship and inspection requirements of the AASHTO LRFD Bridge Construction Specifications and this specification as applicable.
- B. No pipe shall be laid ~~which that~~ is excessively cracked (in accordance with ~~pers~~ Subsection 603.03.07, "Inspection"), checked, spalled, or damaged, and all such sections of pipe shall be permanently removed from the work. Pipes, ~~which that~~ show defects due to handling, shall be rejected at the site of the installation regardless of prior acceptance.

**603.03.02 EARTHWORK**

- A. Where pipes are to be installed in new embankment (projection), the embankment shall first be constructed to the required elevation as set forth below. The height of embankment to be constructed in advance of installing the pipe may be varied when permitted by the Engineer.
- B. In the case of pipes 24 inches ~~(600 millimeters)~~ or less in diameter, the roadway embankment shall be constructed to an elevation of 6 inches ~~(150 millimeters)~~ above the grade proposed for the top of the pipe, after which the trench shall be excavated and the pipe installed.
- C. In the case of pipes more than 24 inches ~~(600 millimeters)~~ in diameter, the roadway embankment shall be constructed to an elevation of 30 inches ~~(750 millimeters)~~ above the grade proposed for the bottom of the pipe, after which the trench shall be excavated and the pipe installed.
- D. When pipe having bells or hubs is used, cross trenches shall be excavated for them to prevent non-uniform loading of the joints.

**603.03.03 LAYING CULVERT PIPE**

- A. Construction installation shall comply with the AASHTO LRFD Bridge Construction Specifications, ~~Section 208, "Trench Excavation and Backfill";~~ and this subsection.
  1. The installation shall be conducted by a certified supervisor/foreman at the crew level who is responsible for the work.
  2. The certified person is the designated installation inspector for the ~~e~~C Contractor and shall generate a daily report attesting to the workmanship for ~~the pipe zone locations as described in Table 2~~ each of the installation components described below.
  3. This does not relieve the ~~e~~C Contractor of responsibility for other Quality Control aspects of this and other specifications.
- B. Installation Components:

## REINFORCED CONCRETE PIPE

603

1. ~~(a)~~ Bedding.
  2. ~~(b)~~ Pipe Condition.
  3. ~~(c)~~ Pipe Installation.
  4. ~~(d)~~ Haunch Compaction.
  5. ~~(e)~~ Complete Pipe Zone Compaction.
- C. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe. Blocking shall not be used to bring the pipe to grade.
- D. Pipe sections shall be checked for alignment and grade at the time of joining the sections.
1. Pipe laying shall begin at the downstream end of the pipeline except for extensions of existing pipes.
  2. Place the bottom of the pipe in contact with the shaped bedding throughout its full length.
  3. The first section of pipe to be laid shall be firmly placed to the designated line and grade at the outlet end with the groove end or bell end pointing in the direction to be followed by the pipe laying.
  4. Maintain the manufacturer's recommended minimum and maximum cover at all times unless otherwise shown in the contract.
  5. Pipe will be inspected before any backfill is placed.
  6. Ensure that no rocks greater than ~~75 mm (3 inches)~~ or other rigid or jagged material is present in the bedding material where pipe may be laid directly on the material.
  7. Take up and relay or replace pipe that is out of alignment, unduly settled, or damaged.
- E. The interior of the pipe shall be kept free of dirt, and other foreign material as the pipe laying progresses, and left clean at the completion of the work. Any pipe, which is not in true alignment or which shows any undue settlement after laying, or is damaged, shall be taken up and re-laid at the Contractor's expenses.
- F. **Backfill:** Prior to placing backfill material, all ~~hand~~lifting holes in concrete culverts shall be completely filled with grout.

**603.03.04 RUBBER GASKETED JOINTS**

- A. Circular reinforced concrete culvert pipe~~7~~ shall use rubber or neoprene gasketed joints.
- B. Rubber gaskets shall not be exposed to the direct rays of the sun for more than 72 hours.
- C. The ~~e~~Contractor shall make every effort to provide a concrete-to-concrete connection and pull the pipe completely home.
1. Should gapping occur due to changes or corrections in horizontal or vertical alignment or radius turns, the gaps shall not exceed the gap tolerance indicated in Table 1.
  2. If pipes are laid that exceed these tolerances, the inner annular space between the pipe sections shall be completely filled with cement mortar (where pipe diameters allow for entry).

3. If pipes are laid that exceed the tolerances in Column 2, the pipe will need to be removed and re-laid or an acceptable concrete collar will need to be installed.

**Table 1 - Maximum Joint Gap Tolerances<sup>1</sup>**

Inner Diameter of Pipe	Column 1	Column 2
	Maximum Joint Gap Tolerance	Maximum Joint Gap Tolerance (with Grouting)
12"-inch to 36"-inch	5/8"-inch	3/4"-inch
42"-inch to 48"-inch	7/8"-inch	1-1/8"-inch
54"-inch to 90"-inch	1-0"-inch	1-1/4"-inch
96"-inch	1- 5/8"-inch	1-3/4"-inch
Sizes <del>a</del> Above 96"-inch up to 144"-inch	As recommended by Manufacturer	As recommended by Manufacturer

- D. Where reinforced concrete collars or bells with rubber gaskets are used at the pipe joints, mortar will not be required in the outer annular space.
- E. Where pipes are used with exposed metal surfaces at the joint, both the inner and outer annular joint spaces between pipe sections must be completely filled with cement mortar, except that pipes less than 24 inches (~~61 centimeters~~) in diameter may be pointed inside by brushing smooth and removing all surplus mortar.
- F. The rubber gasket shall be the sole element depended upon to make the joint watertight for the purposes intended.

**603.03.05 SIPHONS AND PRESSURE PIPE**

- A. Reinforced concrete pipe used for siphons or pressure pipe shall be laid in accordance with the above provisions, be connected by flexible, watertight rubber gasket joint and, prior to backfilling, be subject to the following hydrostatic test:
1. The pipeline shall be filled with water at a hydrostatic head of that required to maintain the design~~ed~~ pressure.
  2. The pressure head shall be maintained for a period of not less than 24 hours and any visible leak or other defects, ~~which~~that develop under test, shall be corrected by the Contractor at ~~his expense~~no additional cost to the Contracting Agency.
  3. Sweating that does not develop into a flow or drip will not be considered as leakage.
  4. The test shall be repeated until all leaks or other defects are eliminated

**603.03.06 JUNCTIONS**

- A. All junctions of laterals with a main line or junctions of 2 or more main lines, which are not made in a manhole or concrete junction structure, shall be in a manufactured wye or tee.
- B. The wye or tee shall be of the same material as the conduits to which they are joined, and shall have the same or greater stiffness as the pipe.

<sup>1</sup> ~~In~~ no case shall maximum joint gap tolerance exceed 1/2 of the length where the gasket seats within the pipe

## REINFORCED CONCRETE PIPE

603

**603.03.07 INSPECTION**

- A. All pipe joints and lengths shall be 100 percent inspected.
1. Inspection and ~~T~~esting shall be performed by the ~~e~~C Contractor during and after installation to ensure proper performance.
  2. Installation, placement, and compaction of bedding and backfill materials, ~~as well as their placement and compaction,~~ shall ~~adhere to the requirements of~~ comply with this section.
  3. During the initial phases of the installation process, inspection shall concentrate on detecting improper practice and poor workmanship.
  4. Errors in line and grade, ~~as well as any~~ improper assembly, ~~and or~~ improper backfill techniques, shall be corrected prior to placing significant backfill or trench fill.
  5. Bell/spigot joints shall be properly assembled to prevent the infiltration of soil fines.
  6. Gaskets shall be properly seated to prevent groundwater infiltration and ~~should~~ shall appear uniformly oriented around the pipe.
  7. Shallow cover installations shall be checked to ensure the minimum cover level is provided.
- B. After the pipe has been bedded and backfilled to subgrade level, internal quality inspection shall be paid for and performed by the Contractor a minimum of 30 days after final backfill has been placed and prior to final acceptance by the Contracting Agency.
1. The line shall be cleaned and inspected for cracks and joint gaps using visual physical measurement or other devices, including but not limited to calibrated television or video cameras, subject to approval by the Engineer.
  2. Cracks in pipes (both longitudinal and circumferential) that are less than 0.10 inch in width are generally considered non-structural flaws and need not be repaired.
  3. Cracks that are equal to or exceed 0.10 inch in width shall require an evaluation by a Nevada licensed professional engineer.
  4. The Contractor's engineer shall provide a recommendation regarding removal or repair subject to approval by the Contracting Agency.
  5. Pipe joints and lengths that do not meet the specification shall be repaired or pipe replaced at ~~the contractors expense~~ no additional cost to the Contracting Agency.
- C. All inspection results shall be submitted and approved by the Engineer before final payment.
1. Any replacement pipe shall also be subject to the same testing.
  2. All inspection and testing results shall be submitted to the Engineer for approval.
- D. The ~~Agency~~ Engineer shall be allowed access to randomly inspect at least 10 percent of the total number of pipe runs.

**04 METHOD OF MEASUREMENT****603.04.01 MEASUREMENT**

- A. Method of measurement shall conform to ~~the requirements of~~ Subsection 601.04.01, "Measurement" and ~~in addition thereto,~~ the ~~following~~ requirements ~~shall apply~~ below.

603

## REINFORCED CONCRETE PIPE

- B. The quantity of precast end sections, culvert pipe, or oval pipe measured for payment will be the number of units of each size of each class complete and in place. Pre-cast pipe and cast-in-place sections that are an integral part of the manhole will not be included in the linear foot measurement for reinforced concrete pipe.
- C. The measurement for the quantity of radius RCP will be measured as standard RCP of the equivalent size.
- D. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

~~05~~ BASIS OF PAYMENT**603.05.01 PAYMENT**

- A. Payment shall conform to ~~the requirements of~~ Subsection 601.05.01, "Payments," and ~~in addition thereto,~~ the following requirements below shall apply.
- B. The accepted quantities of reinforced concrete pipe measured as specified in Subsection 603.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~ for reinforced concrete pipe of the class and size specified, which shall be full compensation for removal of existing pavement (only if pavement removal is not included with roadway excavation) trench excavation, furnishing and placing bedding and backfill material, Type II aggregate base, compaction, furnishing and placing pipe and jointing mortar, covering open ends of laterals with plywood, cut and join connections, de-watering of trench, shoring, disposal of excess excavated material, protection and restoration, potholing to determine location of existing utilities, temporary pavement, video inspection cost, related items of work not otherwise provided for, and for all labor, tools, and equipment necessary to complete the work as shown on the plans, as specified herein, and as directed by the Engineer.
- C. End sections will be paid for at the contract unit price bid per each for the kind and sizes specified complete and in place, which payment shall include structure excavation and backfill for precast end sections.
- D. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- E. Payment will be made under:

**PAY ITEM****PAY UNIT**

(Size) Reinforced Concrete Pipe (class).....	Linear Foot <del>(Meter)</del>
(Size) Oval Reinforced Concrete Pipe (class).....	Linear Foot <del>(Meter)</del>
(Size) Reinforced Concrete Siphon Pipe (class).....	Linear Foot <del>(Meter)</del>
(Size) Reinforced Concrete Pipe (class) Jacked.....	Linear Foot <del>(Meter)</del>
(Size) Precast End Section.....	Each
(Size) Precast Oval End Section.....	Each

**SECTION 604****CORRUGATED METAL PIPE AND METAL ARCH PIPE****DESCRIPTION****604.01.01 GENERAL**

- A. This work shall consist of furnishing and installing corrugated metal pipe, corrugated metal arch pipes and corrugated metal slotted pipe and the relaying of salvaged corrugated metal pipe and pipe arches at locations shown on the plans, or established by the Engineer, and in accordance with the design requirements of Section 709, "Metal and Thermoplastic Pipe", and where indicated in these specifications.
- B. The installation shall conform to the ~~requirements of~~ AASHTO LRFD Bridge Construction Specifications and ~~where indicated in~~ these specifications.

~~REFERENCE CODES AND STANDARDS:~~

- ~~(a) Uniform Standard Specifications for Public Works' Construction Off-site Improvements, Clark County Area, Nevada that will henceforth be referred to as "USS" Specifications and Drawings~~
- ~~(b) Contract Special Provisions and Drawings~~
- ~~(c) NRS 338.176, NAC 625.550~~
- ~~(d) Most current ASTM, AASHTO, ACI or NDOT test & inspection procedures~~
- ~~(e) Related Interagency Quality Assurance Committee (IQAC) procedures at: [www.accessclarkcounty.com/depts/public\\_works/Pages/iqac.aspx](http://www.accessclarkcounty.com/depts/public_works/Pages/iqac.aspx)~~

**MATERIALS****604.02.01 GENERAL**

- A. Materials and their use shall conform to ~~the applicable requirements of Subsection 601.02.01, of Section 601, "Pipe Culverts -- General,"~~ Section 709, "Metal and Thermoplastic Pipe," and ~~in addition thereto, the following requirements below shall apply: Design in accordance with Section 709, "Metal and Thermoplastic Pipe".~~
- B. Prior to the use of these materials, the Contractor shall submit to the Engineer for approval a document certifying that the material meets these specifications and Section 709, "Metal and Thermoplastic Pipe", from an authorized source approved by the Interagency Quality Assurance Committee (IQAC).
- C. Corrugated metal pipe shall be furnished in the sizes, gauges, and corrugation patterns as shown on the project plans.
- D. Flared end sections (metal headwalls) shall conform to the details and dimensions shown on the plans and except for shape, shall conform to the requirements of this section for corrugated metal pipe culverts.

**CONSTRUCTION****604.03.01 GENERAL**

- A. Construction methods shall conform to ~~the requirements of Subsections 601.03.01, "General Earthwork," through Subsection 601.03.06, "Extending Existing Culverts -- General,"~~ and ~~in addition thereto shall meet the following requirements below.~~
  - 1. All pipe installation shall conform to the workmanship and inspection requirements of AASHTO LRFD Bridge Construction Specifications AASHTO M36, AASHTO M196, and this specification as applicable.
  - 2. The more stringent requirements shall apply.



604

## CORRUGATED METAL PIPE AND METAL ARCH PIPE

- B. Prior to the use of these materials, the Contractor shall submit to the Engineer for approval a document certifying that the material meets these specifications and Section 709, "Metal and Thermoplastic Pipe", from an authorized source approved by the Interagency Quality Assurance Committee (IQAC).
1. If the manufacturer is not authorized, the ~~e~~Contractor ~~must~~shall provide a Quality Control Program with test and inspection data to the Engineer for approval.
  2. Subsequent submittals and reports ~~are to~~shall be reviewed by the Contractor for compliance, then transmitted to the Engineer for approval.
  3. It is then the responsibility of the Contractor to visit the manufacturer ~~in order to~~as ensure that the non-authorized source is conforming to the QC program requirement.
- C. Culverts shall be handled ~~in such a manner so~~as to prevent bruising, scaling, ~~or~~and breaking of the spelter coating. Pipes, ~~which~~that show defects due to handling, shall be rejected at the site of the installation regardless of prior acceptance.

**604.03.02 EARTHWORK**

- A. Where pipes are to be installed in new embankment (projection), the embankment shall first be constructed to the required elevation as set forth below. The height of embankment to be constructed in advance of installing the pipe may be varied when permitted by the Engineer.
- B. In the case of pipes ~~twenty-four (24)~~24 inches ~~(600 millimeters)~~ or less in diameter, the roadway embankment ~~shall be constructed to an elevation of six (6)~~shall be constructed to an elevation of six (6) inches ~~(150 millimeters)~~(150 millimeters) above the grade proposed for the top of the pipe, after which the trench shall be excavated and the pipe installed.
- C. In the case of pipes more than ~~twenty-four (24)~~24 inches ~~(600 millimeters)~~ in diameter, the roadway embankment shall be constructed to an elevation of ~~thirty (30)~~thirty (30) inches ~~(750 millimeters)~~(750 millimeters) above the grade proposed for the bottom of the pipe, after which the trench shall be excavated and the pipe installed.
- D. When pipe having bells or hubs is used, cross trenches shall be excavated for the ~~m~~pipe to prevent non-uniform loading of the joints.

**604.03.03 LAYING CULVERT PIPE**

- A. ~~Construction~~Installation shall comply with the AASHTO LFRD Bridge Construction Specifications; Section 208, "Trench Excavation and Backfill"; and this subsection.
1. The installation shall be conducted by a certified supervisor/foreman at the crew level who is responsible for the work.
  2. The certified person is the designated installation inspector for the ~~e~~Contractor and shall generate a daily report attesting to the workmanship for ~~the pipe zone locations as described in Table 1~~each of the installation components described below.
  3. This does not relieve the ~~e~~Contractor of responsibility for other Quality Control aspects of this and other specifications.
- B. Installation Components:
1. ~~(a)~~ Bedding
  2. ~~(b)~~ Pipe Condition



## CORRUGATED METAL PIPE AND METAL ARCH PIPE

604

3. ~~(e)~~ Pipe Installation
  4. ~~(d)~~ Haunch Compaction
  5. ~~(e)~~ Complete pipe zone compaction
- C. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe. Blocking shall not be used to bring the pipe to grade.
- D. Pipe sections s shall be checked for alignment and grade at the time of joining the sections.
1. ~~They~~ Pipe sections shall be fitted and matched so that when laid in the work, they sections ~~will~~ form a smooth and uniform invert.
  2. Pipe laying shall begin at the downstream end of the pipeline except for extensions of existing pipes.
  3. Place the bottom of the pipe in contact with the shaped bedding throughout its full length.
  4. The first section of pipe to be laid shall be firmly placed to the designated line and grade at the outlet end.
  5. Corrugated metal pipe with riveted seams shall be ~~so~~-laid so that flow is over the lap of the sheets.
  6. Field joints shall be made by butting the ends of pipe together and the sections joined with a band bolted firmly in place.
  7. Coupling band details for corrugated metal pipe arches shall be as shown on the ~~Standard Plans~~ project drawings or approved working drawings.
  8. Maintain the manufacturer's recommended minimum and maximum cover at all times unless otherwise shown in the contract.
- E. The interior of the pipe shall be kept free of dirt, and other foreign material as the pipe laying progresses, and left clean at the completion of the work. Any pipe, ~~which~~ that is not in true alignment, ~~or which~~ that shows any undue settlement after laying, or that is damaged, shall be taken up and re-laid at ~~the Contractor's expenses~~ no additional cost to the Contracting Agency.
- F. Pipe ~~will~~ shall be inspected before any backfill is placed.
1. Ensure that no rocks greater than ~~seventy-five (75) mm (3 inches in diameter)~~ or other rigid or jagged material is present in the bedding material where pipe may be laid directly upon the material ~~it~~.
  2. Ensure that no "floating" occurs during installation of plastic pipe culverts.
  3. Take up and relay or replace pipe that is out of alignment, unduly settled, or damaged.

**604.03.04 SLOTTED PIPE**

- A. This ~~specification~~ subsection covers Slotted Drain pipe used for the removal of surface water as shown on the plans.
1. The corrugated steel pipe (CSP) used to manufacture the Slotted Drain shall comply with ~~meet the requirements of~~ Section 709, "Metal and Thermoplastic Pipe".
  2. The diameter, gauge, and metallic coating shall be as shown on the plans.

- B. The corrugated steel pipe shall have a minimum of ~~two~~ 2 re-rolled annular ends.
1. The connecting bands shall be modified Hugger-type bands to secure the pipe and prevent infiltration of the backfill.
  2. When the ~~S~~slotted ~~D~~rain is banded together, the adjacent grates shall have a maximum ~~three~~ (3)-inch gap.
- C. The grates shall be manufactured from ASTM A1011, Grade -26 steel and fabricated in accordance with ~~as per~~ Caltrans Standard Plan -D98B<sup>1</sup>.
1. The spacers and bearing bars (sides) shall be 3/16-~~inches~~ material plus or minus 0.008 inches.
  2. The spacers shall be on ~~six~~ (6)-~~inches~~ centers and welded on both sides to each bearing bar (sides) with four ~~(4)~~ 1-1/4-~~inch~~ long 3/16-~~inch~~ fillet welds on each side of the bearing bar.
  3. The minimum results for an in-place spacer pulled perpendicular to the bearing bar shall be:
    - a. T = 12,000 pounds for 2-1/2-~~inch~~ grate.
    - b. T = 15,000 pounds for ~~six~~ (6)-~~inches~~ grate.
- D. The grates shall be vertical (straight sides) or trapezoidal with a 1-3/4-~~inch~~ opening in the top and 30°-~~degree~~ slanted spacers, as shown on the plans. The grate shall be 2-1/2-~~inches~~ or ~~six~~ (6)-~~inches~~ high as shown on the plans.
- E. If variable height grate is shown on the plans, the grate shall be vertical (straight sides) with a 1-3/4-~~inch~~ opening in the top and spacers will~~shall~~ be placed on ~~six~~ (6)-~~inch~~ centers.
1. The top and bottom grates shall be 2-1/2-~~inches~~ or ~~six~~ (6)-~~inches~~ high, as needed.
  2. ~~and~~ Plate extenders shall be attached to achieve the slope shown on the plans.
- F. The grate (and plate extenders for variable height grate) shall be galvanized in accordance with ASTM A123, except with a ~~two~~ (2)-~~ounce~~ galvanized coating. The grate shall be fillet welded with a minimum weld ~~one~~ (1)-~~inch~~ long to the CSP on each side of the grate at every other corrugation.
- G. Finished ~~S~~slotted ~~D~~rain, in ~~twenty~~ (20)-~~foot~~ nominal lengths, will~~shall~~ satisfy the following tolerances:
1. Vertical bow: ±3/8 ~~inch~~.
  2. ~~Horizontal~~ bow: ±5/8 ~~inch~~.
  3. ~~Twist~~: ±1/2 ~~inch~~.

#### 604.03.05 RUBBER GASKETED JOINTS

- A. Rubber gaskets of the type requiring lubrication shall ~~be lubricated with~~ use the lubricant supplied by the manufacturer of the pipe.
1. Manufactured self-~~lubricating~~ gaskets are also acceptable.

<sup>1</sup> Standard plans are on the Caltrans ~~W~~website, [www.dot.ca.gov](http://www.dot.ca.gov)

## CORRUGATED METAL PIPE AND METAL ARCH PIPE

604

2. Rubber gaskets shall not be exposed to the direct rays of the sun for more than ~~seventy-two (72)~~ hours.
- B. The eContractor shall make every effort to provide a tight connection and pull the pipe completely home.
1. Should gapping occur due to changes or corrections in horizontal or vertical alignment or radius turns, the gaps shall not exceed the gap tolerance indicated in Table 1.
  2. If pipes are laid that exceed the maximum gap tolerance, the pipe ~~will need to~~ shall be removed and re-laid.

<u>Table 1 - Maximum Joint Gap</u>	
Inner Diameter of Pipe	Maximum Joint Gap Tolerance
10" <u>inches</u> to 12" <u>inches</u>	3/4" <u>inch</u>
15" <u>inches</u> to 30" <u>inches</u>	1-1/4" <u>inch</u>
36" <u>inches</u> to 54" <u>inches</u>	1-1/2" <u>inch</u>
60" <u>inches</u>	1-3/4" <u>inch</u>

**604.03.06 SIPHONS AND PRESSURE PIPE**

- A. Pipe used for siphons or pressure pipe shall be laid in accordance with the above provisions, be connected by flexible, watertight rubber gasketed ~~gasket~~ joint, and prior to backfilling, be subject to the following hydrostatic test:
1. The pipeline shall be filled with water at the hydrostatic head ~~of that~~ required to maintain the designed pressure.
  2. The pressure head shall be maintained for a period of not less than ~~twenty-four (24)~~ hours and any visible leak or other defects, ~~which that~~ develop under test, shall be corrected by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.
  3. Sweating that does not develop into a flow or drip will not be considered as leakage.
  4. The test shall be repeated until all leaks or other defects are eliminated.

**604.03.07 JUNCTIONS**

- A. All junctions of laterals with a main line or junctions of ~~two~~ 2 or more main lines, ~~which that~~ are not made in a manhole or concrete junction structure, shall be in a manufactured wye or tee or tee.
- B. The wye or tee shall be of the same material as the conduits to which they are joined, and shall have the same or greater stiffness as the pipe.

**604.03.08 INSPECTION AND DEFLECTION TESTING**

- A. All pipe joints and lengths shall be ~~one hundred (100)~~ percent inspected.
1. ~~"Inspection and Ttesting"~~ shall be performed by the eContractor during and after installation to ensure proper performance.
  2. Installation, placement, and compaction of bedding and backfill materials, ~~as well as their placement and compaction~~, shall ~~adhere to the requirements of~~ comply with this specification.

3. During the initial phases of the installation process, inspection shall concentrate on detecting improper practice and poor workmanship such as sags in grade, deflection, joint gap, gaskets, dents, coating integrity, and condition of the lockseam.
  4. Errors in line and grade, as well as any improper assembly or backfill techniques, shall be corrected prior to placing significant backfill or trench fill.
  5. Coupling bands shall be properly indexed with the corrugation and tightened to prevent the infiltration of soil fines.
  6. Gaskets shall be properly seated to prevent groundwater infiltration and ~~should~~shall appear uniformly oriented around the pipe.
  7. Shallow cover installations shall be checked to ensure the minimum cover level is provided.
- B. After the pipe has been bedded and backfilled to subgrade level, internal quality inspection shall be paid for and performed by the Contractor a minimum of ~~thirty (30)~~ days after final backfill has been placed.
1. The line shall be cleaned and inspected for damage, joint gaps, and deflection using visual physical measurement or other devices, including but not limited to calibrated television or video cameras, subject to approval by the Engineer.
  2. Damaged pipe ~~will need to~~shall be repaired or replaced.
  3. The replacement pipe shall also be subject to the same testing.
  4. Joints that do not meet the specification shall be repaired or pipe replaced at ~~the contractor's expense~~no additional cost to the Contracting Agency.
  5. All inspection results shall be submitted and approved by the Engineer before final payment.
- C. The video camera shall physically verify quality of the pipe installation and ~~is~~shall not ~~be~~ limited by poor lighting, water flow, pipe length, or other limiting conditions of the installed environment.
- D. For pipe greater than ~~thirty-six (36)~~ inches ~~(900 mm)~~ inside diameter, deflection determination by physical measurement may be performed using ~~four~~4 cross section measurements taken beginning at the vertical and for each 90-~~degree~~0 interval with a longitudinal frequency of once every ~~ten (10)~~ feet of the pipe.
- E. The minimum diameter at any point shall be ~~five (5)~~ percent less than the nominal diameter (minus fabrication tolerance ~~per~~in accordance with AASHTO M36, Section 8.0) for the type of pipe installed.
- F. For locations where pipe deflection exceeds ~~five (5)~~ percent of the inside diameter and/or failure of other quality pipe criteria, an evaluation shall be conducted by the Contractor and a recommendation by their Contractor's Nevada registered ~~P~~professional ~~E~~engineer submitted to the ~~Agency~~ Engineer for review and approval, addressing ~~considering~~ the severity of the deflection, structural integrity, environmental conditions, and the design service life of the pipe. For locations where pipe deflection exceeds ~~seven and a half (7.5)~~ percent of the inside diameter, remediation or replacement of the pipe is required.
- G. Unless otherwise permitted, pipe that does not meet the specified pipe tolerance ~~ation~~ shall be uncovered and, if not damaged, corrected as per in accordance with the Agency ~~A~~Engineer approved recommendation from the Contractor at ~~the contractor's expense~~no additional cost to the Contracting Agency.

## CORRUGATED METAL PIPE AND METAL ARCH PIPE

604

1. Do not reinstall damaged pipe, but remove and replace with new pipe.
  2. The replacement pipe shall also be subject to the same testing.
- H. All inspection and testing results shall be submitted to the Engineer for approval. The ~~Agency~~ Engineer shall be allowed access to randomly inspect at least ~~ten~~ (10) percent of the total number of pipe runs.

## METHOD OF MEASUREMENT

## 604.04.01 MEASUREMENT

- A. Method of measurement shall conform to ~~the requirements of~~ Subsection 601.04.01, "Measurement," and ~~in addition thereto,~~ the following requirements below shall apply.
- B. The quantity of corrugated metal pipe measured for payment will by the number of linear feet of each size and class complete and in place.
- ~~B.C.~~ C. The quantity of corrugated metal ~~and~~ sections for culvert pipe or pipe arch measured for payment will be the number of units of each size of each class complete and in place.
- ~~The contract unit price paid for metal pipe shall be full compensation for excavating trench, disposal of excess material, hauling, placing and compacting backfill, de-watering, compaction, shoring, furnishing and placing pipe, pipe fittings, protection and restoration, if damaged, of all existing facilities and improvements required to remain in place, related items of work not otherwise provided for, and for all labor, tools, and equipment necessary to complete the work as shown on the drawings, as specified herein, and as directed by the Engineer.~~
- ~~C.D.~~ D. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

## 604.05.01 PAYMENT

- A. Payment shall conform to ~~the requirements of~~ Subsection 601.05.01, "Payment," and ~~in addition thereto,~~ the following requirements below shall apply.
- B. The accepted quantities of corrugated metal pipe, measured as specified in Subsection 604.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meters)~~ for the types and sizes specified. The contract unit price paid for metal pipe shall be full compensation for excavating trench, disposal of excess material, hauling, placing and compacting backfill, dewatering, compaction, shoring, furnishing and placing pipe, pipe fittings, protection and restoration, if damaged, of all existing facilities and improvements required to remain in place, related items of work not otherwise provided for, and for all labor, tools, and equipment necessary to complete the work as shown on the drawings, as specified herein, and as directed by the Engineer.
- C. End sections will be paid for at the contract unit price bid per each for the kind and size specified, which payment shall include structure excavation and backfill for fabricated end sections.
- D. When culvert pipe is designated to be relayed, hauling of the pipe, from the site of removal or from the place where stored to the point or points at which they are to be reinstalled, shall be considered subsidiary to the pipe item and no further compensation will be allowed.
- E. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

604

## CORRUGATED METAL PIPE AND METAL ARCH PIPE

F. Payment will be made under:

PAY ITEM	PAY UNIT
(Size) Corrugated Metal Pipe (type) .....	Linear Foot- <del>(Meter)</del>
(Size) Corrugated Metal Pipe (type) Jacked.....	Linear Foot- <del>(Meter)</del>
(Size) Relay Culvert Pipe (type) .....	Linear Foot- <del>(Meter)</del>
(Size) Corrugated Metal Arch Pipe (type).....	Linear Foot- <del>(Meter)</del>
(Size) Corrugated Metal Siphon Pipe (type).....	Linear Foot- <del>(Meter)</del>
(Size) Corrugated Metal Slotted Pipe (type).....	Linear Foot- <del>(Meter)</del>
(Size) Corrugated Metal End Section (type).....	Each
(Size) Corrugated Metal Arch End Section (type) .....	Each

**SECTION 605****THERMOPLASTIC PIPE CULVERTS****DESCRIPTION****605.01.01 GENERAL**

- A. This work shall consist of furnishing and installing thermoplastic pipe culverts, storm drains, and conduits of the size, and dimensions and at locations shown on the plans or established by the Engineer ~~and in accordance with the requirements of~~.
- B. ~~the~~ installation shall conform to ~~the requirements of~~ Section 709, "Metal and Thermoplastic Pipe," and ~~where indicated in~~ these specifications ~~and including~~ exceptions/additions in these specifications below. The more stringent requirements shall apply.

**605.01.02 REFERENCE CODES AND STANDARDS:**

- ~~a) Uniform Standard Specifications for Public Works' Construction Off-site Improvements, Clark County Area, Nevada that will henceforth be referred to as "USS"~~
- ~~b) Contract Special Provisions and Drawings~~
- ~~c) NRS 338.176, NAC 625.550~~
- ~~d) Most current ASTM, AASHTO, ACI or NDOT test & inspection procedures~~
- ~~e) Related Interagency Quality Assurance Committee (IQAC) procedures at: [www.accessclarkcounty.com/depts/public\\_works/Pages/iqac.aspx](http://www.accessclarkcounty.com/depts/public_works/Pages/iqac.aspx)~~

**MATERIALS****605.02.02 GENERAL**

- A. Materials and their use shall conform to ~~the applicable requirements of Subsection 601.02.01, "Pipe Culverts - General," and in addition thereto, the following requirements shall apply below~~.
- B. Prior to the use of these materials, the Contractor shall submit to the Engineer for approval a document certifying that the material meets these specifications and Section 709, "Metal and Thermoplastic Pipe," from an authorized source approved by the Interagency Quality Assurance Committee (IQAC).

**605.02.03 MARKINGS**

- A. Markings on pipe shall be per in accordance with ~~the appropriate specification of~~ Section 709, "Metal and Thermoplastic Pipe."

**CONSTRUCTION****605.03.01 GENERAL**

- A. Construction methods shall conform to ~~the requirements of~~ Subsections 601.03.01, "Earthwork," through Subsection 601.03.06, "Extending Existing Culverts," ~~of Section 601, "Pipe Culverts - General," and in addition~~ shall conform to the workmanship and inspection requirements of AASHTO LRFD Bridge Construction Specifications, AASHTO M278, AASHTO M294, ~~or~~ AASHTO M304, and this section specification as applicable. The more stringent requirements s shall apply.



605

## THERMOPLASTIC PIPE CULVERTS

- B. The pipe shall be excavated and backfilled ~~per~~ in accordance with ~~s~~Section 208, "Trench Excavation and Backfill."
- C. Non-UV protected pipe shall be protected from direct sunlight until the day of installation.

**605.03.02 EARTHWORK**

- A. Where pipes are to be installed in new embankment (projection), the embankment shall first be constructed to the required elevation as set forth below. The height of embankment to be constructed ~~in advance of~~ before installing the pipe may be varied when permitted by the Engineer.
- B. In the case of pipes ~~twenty-four (24) inches (600 millimeters)~~ or less in diameter, the roadway embankment ~~shall be constructed to an elevation of six (6) inches (150 millimeters)~~ above the grade proposed for the top of the pipe, after which the trench shall be excavated and the pipe installed.
- C. In the case of pipes more than ~~twenty-four (24) inches (600 millimeters)~~ in diameter, the roadway embankment shall be constructed to an elevation of ~~thirty (30) inches (750 millimeters)~~ above the grade proposed for the bottom of the pipe, after which the trench shall be excavated and the pipe installed.
- D. When pipe having bells or hubs is used, cross trenches shall be excavated for the ~~m~~ pipe to prevent non-uniform loading of the joints.

**605.03.03 LAYING CULVERT PIPE**

- A. ~~Construction~~ iInstallation shall comply with the AASHTO LRFD Bridge Construction Specifications, i Section 30, ~~and~~ i Section 208, "Trench Excavation and Backfill"; and this subsection.
  - 1. The installation shall be conducted by a certified supervisor/foreman at the crew level who is responsible for the work.
  - 2. The certified person is the designated installation inspector for the ~~e~~ CContractor and shall generate a daily report attesting to the workmanship for ~~the pipe zone locations as described in Table 2~~ each of the installation components described below.
  - 3. This does not relieve the ~~e~~ CContractor of responsibility for other Quality Control aspects of this and other specifications.
- B. Installation Components:
  - 1. ~~a)~~ Bedding
  - 2. ~~b)~~ Pipe Condition
  - 3. ~~c)~~ Pipe Installation
  - 4. ~~d)~~ Haunch Compaction
  - 5. ~~e)~~ Complete pipe zone compaction
- C. Pipe section shall be checked for alignment and grade at the time of joining the sections. All pipes shall be laid true to the designated line, and grade, ~~and camber, and upgrade,~~ unless otherwise permitted by the Engineer.
- D. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe. Blocking shall not be used to bring the pipe to grade.



## THERMOPLASTIC PIPE CULVERTS

605

- E. Pipe laying shall begin at the downstream end of the pipeline except for extensions of existing pipes.
1. Place the bottom of the pipe in contact with the bedding throughout its full length.
  2. Place the spigot or outside circumferential laps of pipes facing upstream such that a shingling effect is obtained.
  3. Place pipe with longitudinal laps or seams with the laps or seams at the sides.
  4. Maintain the manufacturer's recommended minimum and maximum cover at all times unless otherwise shown in the contract.
- F. Pipe ~~will~~shall be inspected before ~~any~~placing backfill ~~is placed~~.
1. Ensure that no rocks or other rigid or jagged material is present in the bedding material where pipe may be laid directly on the material.
  2. Ensure that no "floating" occurs during installation of plastic pipe culverts.
  3. ~~Take up~~Remove and relay or replace pipe that is out of alignment, unduly settled, or damaged.

**605.03.04 RUBBER GASKETED JOINTS**

- A. Rubber gaskets shall not be exposed to the direct rays of the sun for more than ~~seventy-two (72)~~ hours.
- B. Rubber gaskets of the type requiring lubrication shall be lubricated with the lubricant supplied by the manufacturer of the pipe. Manufactured self-lubricating gaskets are also acceptable.
- C. The ~~e~~Contractor shall make every effort to provide a tight connection and pull the pipe completely home.
1. Should gapping occur due to changes or corrections in horizontal or vertical alignment or radius turns, the gaps shall not exceed the gap tolerance indicated in Table 1.
  2. If pipes are laid that exceed the maximum, the pipe will need to be removed and re-laid.

**Table 1 - Maximum Joint Gap<sup>1</sup>**

Inner Diameter of Pipe	Maximum Joint Gap Tolerance
10"- <u>inch</u> to 12"- <u>inch</u>	3/4"- <u>inch</u>
15"- <u>inch</u> to 30"- <u>inch</u> - <u>inch</u>	1-1/4"- <u>inch</u>
36"- <u>inch</u> to 54"- <u>inch</u>	1-1/2"- <u>inch</u>
60"- <u>inch</u>	1-3/4"- <u>inch</u>

**605.03.05 SIPHONS AND PRESSURE PIPE**

- A. Pipe used for siphons or pressure pipe shall be laid in accordance with the above provisions, be connected by flexible, watertight rubber gasketed joint~~7~~, and 1 prior to backfilling, be subject to the following hydrostatic test:

<sup>1</sup> 1in no case shall maximum joint gap tolerance exceed ~~one half (1/2)~~ of 1/2 the length where the gasket seats within the pipe

605

## THERMOPLASTIC PIPE CULVERTS

1. The pipeline shall be filled with water at at the hydrostatic head ~~of that~~ required to maintain the designed pressure.
2. The pressure head shall be maintained for a period of not less than ~~twenty-four (24)~~ hours and any visible leaks or other defects, ~~which that~~ develop under test, shall be corrected by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.
3. Sweating that does not develop into a flow or drip will not be considered as leakage.
4. The test shall be repeated until all leaks or other defects are eliminated.

**605.03.06 JUNCTIONS**

- A. All junctions of laterals with a main line or junctions of ~~two~~ 2 or more main lines, ~~which that~~ are not made in a manhole or concrete junction structure, shall be in a manufactured wye or tee.
- B. The wye or tee shall be of the same material as the conduits to which they are joined, and shall have the same or greater stiffness as the pipe.

**605.03.07 INSPECTION AND DEFLECTION TESTING**

- A. All pipe joints and lengths shall be ~~one hundred (100)~~ percent inspected.
  1. Installation, placement, and compaction of bedding and backfill materials, ~~as well as their placement and compaction~~, shall ~~adhere~~ conform to ~~the requirements of~~ this specification.
  2. During the initial phases of the installation process, inspection shall concentrate on detecting improper practice and poor workmanship.
  3. Errors in line and grade, ~~as well as any~~ improper assembly, ~~or~~ and improper backfill techniques, shall be corrected prior to placing significant backfill or trench fill.
  4. Joints shall be properly assembled to prevent the infiltration of soil fines.
  5. Gaskets shall be properly seated to prevent groundwater infiltration and ~~should~~ shall appear uniformly oriented around the pipe.
  6. Shallow cover installations shall be checked to ensure the minimum cover level is provided.
- B. After the pipe has been bedded and backfilled to subgrade level, internal quality inspection shall be paid for and performed by the Contractor a minimum of ~~thirty (30)~~ days after final backfill has been placed.
  1. The line shall be cleaned and inspected for damage, joint gaps, and deflection using visual physical measurement or other devices, including but not limited to calibrated television or video cameras, subject to approval by the Engineer.
  2. Damaged pipe shall be repaired or replaced.
  3. The replacement pipe shall also be subject to the same testing.
  4. Joints that do not meet the specification shall be repaired or pipe replaced at no additional cost to the Contracting Agency. ~~devices, including but not limited to calibrated television or video cameras, subject to approval by the Engineer.~~

~~Damaged pipe will need to be repaired or replaced.~~

## THERMOPLASTIC PIPE CULVERTS

605

~~The specification shall be repaired or pipe replaced at the contractor's expense.~~

5. All inspection results shall be submitted and approved by the Engineer before final payment.
- C. The video camera shall physically verify quality of the pipe installation and ~~is~~shall not ~~be~~ limited by poor lighting, water flow, pipe length, or other limiting conditions of the installed environment.
- D. For pipe greater than ~~thirty-six (36)-inch (900-mm)~~ inside diameter, deflection determination by physical measurement may be performed using ~~four~~4 cross section measurements taken beginning at the vertical and for each 90-~~degree~~0 interval with a longitudinal frequency of once every ~~ten (10)~~ feet of the pipe.
- E. The minimum diameter at any point shall be ~~five (5)~~ percent less than the nominal diameter (minus fabrication tolerance ~~per~~in accordance with AASHTO M294, Section 7.2.3) of the pipe being tested.
- F. If a mandrel is used, it must be approved before use.
  1. Mandrel~~It~~ shall be ~~a~~ rigid, nonadjustable, odd-numbered legged (minimum 9 legs) ~~mandrel~~ having a length not less than its nominal diameter.
  2. Mandrel shall~~It must~~ be fitted with pulling rings at each end, stamped or engraved on some segment other than a runner with the nominal pipe size and mandrel outside diameter, and furnished in a suitable carrying case.
  3. Use of an unapproved mandrel or a mandrel altered or modified after approval will invalidate the test.
  4. If the mandrel fails to pass, the pipe is over-deflected.
  5. A properly sized proving ring shall be used to check or test the mandrel for accuracy.
  6. The mandrel shall be pulled through the pipe with a force not greater than ~~one-thousand (1,000)~~ pounds.
- G. For locations where pipe deflection exceeds ~~five (5)~~ percent of the inside diameter and/or fails other quality pipe criteria, an evaluation shall be conducted by the Contractor and a recommendation by the ~~it~~ Contractor's Nevada registered ~~P~~professional ~~E~~engineer submitted to the ~~Agency~~Engineer for review and approval ~~considering~~addressing the severity of the deflection, structural integrity, environmental conditions, and the design service life of the pipe. For locations where pipe deflection exceeds ~~seven-and-one-half (7.5)~~ percent of the inside diameter, remediation or replacement of the pipe is required.
- H. Unless otherwise permitted, pipe that does not meet the specification shall be uncovered and, if not damaged, corrected ~~as per~~in accordance with the ~~Agency~~Engineer ~~A~~approved recommendation from the Contractor at ~~the contractor's expense~~no additional cost to the Contracting Agency.
  1. Do not reinstall damaged pipe, but remove and replace with new pipe.
  2. The replacement pipe shall also be subject to the same testing.
- I. The ~~Agency~~Engineer shall be allowed access to randomly inspect at least ~~ten (10)~~ percent of the total number of pipe runs.

METHOD OF MEASUREMENT**605.04.01 MEASUREMENT**

- A. Method of measurement shall conform to ~~the requirements of~~ Subsection 601.04.01, "Measurement," and ~~in addition thereto,~~ the ~~following~~ requirements ~~shall apply below~~.
- B. The quantity of thermoplastic pipe measured for payment will be the number of linear feet complete and in place.
- C. The quantity of thermoplastic pipe end sections measured for payment will be the number of units of each size of each class complete and in place.
- ~~C. The contract unit price paid for thermoplastic pipe shall be full compensation for excavating trench, disposal of excess material, hauling, placing and compacting backfill, de-watering, compaction, shoring, furnishing and placing pipe, pipe fittings, video inspection, protection and restoration, if damaged, of all existing facilities and improvements required to remain in place, related items of work not otherwise provided for, and for all labor, tools and equipment necessary to complete the work as shown on the drawings, as specified herein and as directed by the Engineer.~~
- D. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**605.05.01 PAYMENT**

- A. Payment shall conform to ~~the requirements of~~ Subsection 601.05.01, "Payment," and ~~in addition thereto,~~ the ~~following~~ requirements ~~shall apply below~~.
- B. The accepted quantities of thermoplastic pipe, measured as specified in Subsection 601.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~ for the types and sizes specified.
- C. The contract unit price paid for thermoplastic pipe shall be full compensation for excavating trench, disposal of excess material, hauling, placing and compacting backfill, dewatering, compaction, shoring, furnishing and placing pipe, pipe fittings, video inspection, protection and restoration, if damaged, of all existing facilities and improvements required to remain in place, related items of work not otherwise provided for, and for all labor, tools and equipment necessary to complete the work as shown on the drawings, as specified herein, and as directed by the Engineer.
- D. End sections will be paid for at the contract unit price bid per each for the kind and size specified, which payment shall include structure excavation and backfill for fabricated end sections.
- E. Compensation for supplying certified mandrels or other deflection testing devices shall be included in the contract unit price paid for the appropriate thermoplastic pipe item and no separate payment will be made there~~of~~for.
- F. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- G. Payment will be made under:

**PAY ITEM****PAY UNIT**

(Size) Thermoplastic Pipe (type) ..... Linear Foot ~~(Meter)~~

THERMOPLASTIC PIPE CULVERTS

605

(Size) Thermoplastic Pipe End Section (type)..... Each  
(only end sections 30-inch and less are allowed)

## SECTION 606

## STRUCTURAL PLATE PIPE AND PIPE ARCH CULVERTS

## DESCRIPTION

## 606.01.01 GENERAL

- A. This work shall consist of furnishing and installing structural plate pipe and pipe arch culverts conforming to ~~the requirements of~~ these specifications, and consisting of the sizes and dimensions required in the plans, and installing ~~such the~~ structures at locations designated in the plans or established by the Engineer, and in conformity with the lines and grades established by the Engineer.
- B. The work shall also include the reinstallation of salvaged structural plate pipe and pipe arch culverts.
- C. Plates for a pipe arch shall form a cross section made up of ~~four~~ 4 circular arcs tangent to each other at their junctions and symmetrical about the vertical axis.
  - 1. The top shall be an arc of not more than ~~one hundred eighty (180)~~ degrees nor less than ~~one hundred fifty-five (155)~~ degrees.
  - 2. The bottom shall be an arc of not more than ~~fifty (50)~~ degrees nor less than ~~ten (10)~~ degrees.
  - 3. The top shall be joined at each end to the bottom by an arc having a radius between ~~sixteen (16 inches)~~ and ~~twenty-one (21)~~ inches (~~41 and 53 centimeters~~) and of not more than ~~eighty-seven and one-half (87-1/2)~~ degrees nor less than ~~seventy-five (75)~~ degrees.

## MATERIAL

## 606.02.01 GENERAL

- A. Materials shall ~~meeting~~ the requirements of AASHTO ~~Designation~~ M-167, "Structural Plate Pipe and Pipe Arches."
- B. If called for in the bid schedule, plates for pipes and pipe arches shall be bituminous coated in accordance with AASHTO ~~Designation~~ M-190, Type A, B or C.
  - 1. When bituminous coating is applied to plates for structural steel plate pipe, arches, and pipe arches, each plate shall have the thickness painted on the inner surface so that the plate thickness can be readily identified.
  - 2. The portion of nuts and bolts, used for assembly of bituminous coated structural steel plate pipes, arches, and pipe arches outside the pipe shall be bituminous coated after installation. The portion of the nuts and bolts inside the pipe need not be bituminous coated.
  - 3. Damaged bituminous coating shall be repaired by the Contractor by applying bituminous material conforming to ~~the provisions of~~ AASHTO ~~Designation~~ M-190 or other approved material.
- C. The bottom plates of structural plate pipes and arches shall be ~~one~~ 1 gauge heavier than the gauge specified in the bid schedule, which will apply to top and side plates. When 1 gauge ~~one (1)~~ is specified, the bottom plates shall also be 1 gauge ~~one (1)~~.

606

## STRUCTURAL PLATE PIPE AND PIPE ARCH CULVERTS

- D. Plates shall be shipped and handled in ~~such~~ a manner ~~as~~ to prevent bruising, scaling, or breaking of the spelter coating.
1. Damaged spelter coating in lieu of the requirements of AASHTO ~~Designation~~ M-36, may be repaired by thoroughly wire brushing the damaged area and removing all loose and cracked spelter coating, after which the cleaned area shall be painted with ~~two~~ 2 coats of zinc oxide-zinc dust paint conforming to ~~the requirements of~~ Federal Specification ~~MIL-P-15145~~.
  2. The paint shall be properly compounded in a suitable vehicle in the ratio of ~~one~~ 1 part zinc oxide to ~~four~~ 4 parts zinc dust by weight.
- E. Planned lengths and sizes are approximate. The Contractor shall not order and deliver the plates until a list of sizes and lengths is furnished ~~to the~~ in Contractor by the Engineer.

## CONSTRUCTION

**606.03.01 PLATE DESCRIPTION**

- A. Plates shall consist of structural units of galvanized corrugated metal.
1. Single plates shall be furnished in standard sizes to permit structure length increments of ~~two (2.)~~ feet ~~(0.6 meters)~~.
  2. ~~(Plates have approximately a~~ ~~two (2.)~~ inch ~~(5-centimeter)~~ lip beyond each end crest, which results in the actual length of a given structure being approximately ~~four (4.)~~ inches ~~(10-centimeters)~~ longer than the nominal length, except when skewed or beveled).
- B. The plates at longitudinal and circumferential seams shall be connected by bolts.
1. Joints shall be staggered so that not more than ~~three (3.)~~ plates come together at any ~~one~~ 1 point.
  2. Each plate shall be curved to ~~one~~ 1 or more circular arcs.

**606.03.02 FABRICATION**

- A. Plates shall be formed to provide lap joints.
1. The bolt holes shall be so punched that all plates having like dimensions, curvature, and the same number of bolts per foot ~~(meter)~~ of seam shall be interchangeable.
  2. Each plate shall be curved to the proper radius so that the cross-sectional dimensions of the finished structure will be as specified.
- B. Bolt Hole Configuration:
1. Unless otherwise specified, bolt holes along those edges of the plates that will form longitudinal seams in the finished structure shall be staggered in rows ~~two (2.)~~ inches ~~(5-centimeters)~~ apart, with ~~one~~ 1 row in the valley and ~~one~~ 1 in the crest of the corrugations.
  2. Bolt holes along those edges of the plates that will form circumferential seams in the finished structure shall provide for a bolt spacing of not more than ~~twelve (12.)~~ inches ~~(30.5-centimeters)~~.
  3. The minimum distance from the center of hole to edge of the plate shall be not less than ~~one and three-fourths~~ 1-3/4 times the diameter of the bolt.

## STRUCTURAL PLATE PIPE AND PIPE ARCH CULVERTS

606

4. The diameter of the bolt holes in the longitudinal seams shall not exceed the diameter of the bolt by more than ~~one-eighth~~(1/8\_)inch ~~(0.3 centimeters)~~.
- C. Burnt edges shall be free from oxide and burrs and shall present a workmanlike finish.
  1. Damaged spelter on the surface of the plates and the edges of cuts shall be repaired as set forth in Subsection 606.02.01, "General\_"; within ~~twenty-four~~(24\_) hours after the cuts are made.
  2. Each cut plate shall be legibly identified to designate its proper position in the finished structure.

**606.03.03 FIELD INSPECTION**

- A. The ~~e~~Engineer shall be furnished with an itemized statement of the number and length of the plates in each shipment by the manufacturer.
- B. Each plate included in a shipment shall conform to ~~the requirements of~~ these specifications.
- C. If ~~twenty-five~~(25\_)percent or more of the plates in any shipment fail to conform to the ~~requirements~~specifications, the entire shipment may be rejected.

**606.03.04 EARTHWORK**

- A. Excavation and backfill shall conform to ~~the requirements of~~ Sections ~~206~~, "Structure Excavation\_" and Section 207, "Structure Backfill\_" or Section 208, "Trench Excavation and Backfill\_" when the culvert is placed in a trench.
- B. The pipe shall be laid in a trench excavated to the lines and grades established by the Engineer.
- C. The bottom of the trench shall be graded and prepared to provide full contact with the pipe throughout its entire length.
- D. Where pipes are to be installed in new embankments on a steep slope or in a difficult location, the height of new embankments may be varied when permitted by the Engineer before installing pipes.
- E. When headwalls are not required and granular materials are used for backfilling, the fill at the ends of the structure shall be sealed against the infiltration of water by bedding the ends of the structure in well-tamped clay as shown on the plans.
- F. When the pipe is laid in hard material, a space below the pipe shall be excavated and replaced with a bed of compacted sand or compacted earth fill. In no place shall the pipe be laid directly on the hard material.
- G. When sand or compacted fill is used, the depth of the sand or compacted fill below the pipe shall not be less than ~~one-third~~(1/3\_)the inside diameter of the pipe with a minimum of ~~four~~(4\_)inches ~~(10 centimeters)~~ and a maximum of ~~twelve~~(12\_)inches ~~(30.5 centimeters)~~ with the exception that an extra ~~one-half~~(1/2\_)inch ~~(1.3 centimeters)~~ shall be added for every foot ~~(meter)~~ the trench exceeds ~~sixteen~~(16\_)feet ~~(4.9 meters)~~ in depth. This bed shall extend at the sides of the pipe at least a distance of ~~one-fourth~~(1/4\_)the outside diameter of the pipe.
- H. When no bedding is specified, the requirements for ~~Class B~~Normal bedding as shown in the ~~Uniform~~ Standard Drawings ~~-Clark County Area~~ shall apply.



**606.03.05 ASSEMBLING**

- A. The structural plate structures shall be assembled in accordance with the manufacturer's assembly instructions.
1. The unsupported edges of all plates shall be held in position by temporary props.
  2. Each row of side plates shall extend far enough to support the plate above until the first complete ring has been assembled.
  3. A sufficient number of bolts shall be progressively installed to hold the plates in position.
  4. Bolts shall not be tightened until tightening will not interfere with the adjustment and matching of additional plates and sections.
  5. Special care shall be exercised in the use of drift pins or pry bars to prevent chipping or injury to the galvanized or other protective coating, and such injury shall be repaired as set forth in Subsection 606.02.01, "General," at ~~the Contractor's expense~~ no additional cost to the Contracting Agency.
  6. After all plates are in place, the bolts shall be progressively and uniformly tightened from ~~one~~ 1 end of the structure, and the tightening operation repeated to be sure that all bolts are tight.
  7. Bolts shall be tightened to a minimum of (a) ~~one hundred (100.)~~ foot-pounds ~~(135.6 joule)~~ of torque for plates of 7-gauge and lighter, and (b) ~~one hundred fifty (150.)~~ foot-pounds ~~(203.04 joule)~~ of torque for plates of 5-gauge and heavier, and shall be rechecked and retightened as necessary just prior to backfilling.
- B. The elliptical-shaped pipes shall be installed with their long diameter vertical, ~~and~~
- C. ~~p~~ Pipe arches shall be installed with their span width horizontal.

**606.03.06 STRUTTING**

- A. When specified, structural plate pipes ~~which that~~ are not fabricated out ~~of~~ round before erection, shall be timber strutted vertically ~~three (3.)~~ percent out ~~of~~ round before placement of the embankment.
- B. The pipe shall be deformed to the required degree by means of suitable jacks.
1. The method of jacking shall ~~be met with the approval of~~ be approved by the Engineer.
  2. A tolerance of ~~twenty-five (25.)~~ percent above or below the specified deformation will be permitted.
- C. Strutting shall be carried uniformly from end to end of the pipe.
- D. The struts shall be left in place until the embankment is complete and compacted, unless otherwise ordered by the Engineer.
- E. In lieu of strutting structural plate pipe, the Contractor may furnish structural plate pipe with the vertical axis fabricated out ~~of~~ round ~~five (5.)~~ percent of the nominal diameter from end to end of the pipe.
1. A tolerance of ~~twenty-five (25.)~~ percent above or below the specified deformation will be permitted.
  2. The deformation shall be made by approved shop methods, and any coating damaged or destroyed shall be repaired or replaced satisfactorily.

## STRUCTURAL PLATE PIPE AND PIPE ARCH CULVERTS

606

**606.03.07 WORKMANSHIP**

- A. ~~It is the essence of these specifications that, i~~n addition to compliance with the details ~~efor~~ construction, the completed pipe shall show careful, finished workmanship in all particulars.
- B. Structural plates on which the spelter coating has been bruised or broken or which shows defective workmanship, shall be rejected, except as ~~herein~~ otherwise specified.
1. The requirement applies not only to the individual plates, but to the shipment on any ~~contract~~ project as a whole.
  2. Among others, the following defects are specified as constituting poor workmanship and the presence of any or all of them in any individual culvert plate, or in general in any shipment, shall constitute sufficient cause for rejection:
    - a. ~~(a)~~ Uneven laps.
    - b. ~~(b)~~ Variation from a straight center line.
    - c. ~~(c)~~ Ragged edges.
    - d. ~~(d)~~ Loose, unevenly lined or spaced bolts.
    - e. ~~(e)~~ Bruised, scaled, or broken spelter coating. (See Subsection ~~606.02.01~~ for exception)
    - f. ~~(f)~~ Dents or bends in the metal itself.

**606.03.08 HEADWALLS**

- A. Where shown on the plans, inlet and outlet headwalls shall be constructed or installed in connection with structural plate pipe.
- B. Where such headwalls are constructed or installed, the ends of pipes shall be placed flush or cut off flush with the headwall face, unless otherwise permitted by the Engineer.
- C. Headwalls shall be constructed to conform to ~~the applicable requirements of Sections~~ 501, "Portland Cement Concrete," and Section 502, "Concrete Structures."

**606.03.09 EXTENDING EXISTING STRUCTURAL PLATE PIPE AND PIPE ARCH CULVERTS**

- A. In case the plans provide for the extension of any old or existing structural plate pipe or pipe arch culverts, the connection of the old and new sections shall be made by:
1. ~~p~~Punching any necessary bolt holes.
  2. ~~f~~Furnishing bolts, nuts, and washers.
  3. ~~e~~Changing location of individual plates on pipe arches, ~~and~~.
  4. Providing any other work required in the completion of the connection in a workmanlike manner.
- B. In all cases where an existing headwall is in place, the concrete shall be completely removed in accordance with ~~the provisions of~~ Section 202, "Removal of Structures and Obstructions."

606

## STRUCTURAL PLATE PIPE AND PIPE ARCH CULVERTS

## METHOD OF MEASUREMENT

**606.04.01 MEASUREMENT**

- A. The materials to be paid for under these specifications will be listed in the contract items by the various sizes, types, and gauges necessary for identification.
- B. The quantity of structural plate pipe or pipe arches measured for payment will be the number of linear feet ~~(meters)~~ complete and in place. The number of linear feet ~~(meters)~~ shall be the average of the top and bottom centerline lengths for structural plate pipe and pipe arches.
- C. Structure excavation and structure backfill, Portland cement concrete, and reinforcement required for headwalls, structures, and other items required to complete the work will be measured and paid for under their respective sections of these specifications.
- D. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**606.05.01 PAYMENT**

- A. The accepted quantities of structural plate pipe and pipe arches measured as specified in Subsection 606.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~ for the types and sizes specified. Full compensation for furnishing structural plate pipe and pipe arches with end finish, including distortion, if required, will be considered as included in the price paid per linear foot ~~(meter)~~ for the plates and pipe involved and no additional compensation will be allowed therefore.
- B. Provisions for handling of whatever water may be encountered at the site shall be an obligation of the Contractor, and payment therefor shall be considered as subsidiary to the items involved, and no further compensation will be allowed therefore.
- C. ~~It is understood that the~~ gauge of metal in the bottom plates of pipes and pipe arches ~~is to shall~~ be of a gauge heavier than that specified in the bid schedule as set forth in Subsection 606.02.01, "General," unless otherwise specified. No separate or additional compensation will be made ~~by reason of~~ supplying the heavier gauge, but compensation therefor shall be considered an integral part of the contract price paid for the gauge specified.
- D. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- E. Payment will be made under:

**PAY ITEM****PAY UNIT**

(Size) Structural Plate Pipe (type) (gauge) .....	Linear Foot <del>(Meter)</del>
(Size) Structural Plate Pipe Arch (type) (gauge) .....	Linear Foot <del>(Meter)</del>

**SECTION 607****UNDERDRAINS****DESCRIPTION****607.01.01 GENERAL**

- A. This work shall consist of constructing underdrains using pipe and drain backfill in accordance with these specifications and in conformity with the lines and grades shown on the plans or established by the Engineer.

**MATERIAL****607.02.01 GENERAL**

- A. Materials shall meet the requirements specified in the following subsections:

<b>Materials</b>	<b>Subsection</b>
Corrugated Metal Pipe for Underdrains	709.03.058
Bituminous Coated Corrugated Metal Pipe for Underdrains	709.03.069
Perforated Concrete Pipe	708.03.03
Clay Pipe	708.03.04
Drain Backfill	704.03.042

- B. When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with material quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.
- C. Materials will be subject to inspection for acceptance as to condition at the latest time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials into the work.
- D. The Contractor shall not order and deliver the pipe until a list of sizes and lengths is furnished ~~to the~~ in Contractor by the Engineer.
- E. Corrugated metal pipe shall be shipped and handled in such a manner as to prevent bruising, scaling, or breaking of the spelter coating.
- F. Corrugated metal pipe with damaged spelter coating may be repaired in accordance with Subsection 604.02.01, ~~of Section 604, "Corrugated Metal Pipe~~ General."
- G. Concrete or clay pipe which is cracked, checked, spalled, or damaged shall be rejected.
- H. Pipes which show defects shall be rejected at the site of the installation regardless of prior acceptance.

**CONSTRUCTION****607.03.01 EARTHWORK**

- A. Excavation and drain backfill shall conform to ~~the requirements of Sections~~ 206, "Structure Excavation," and Section 209, "Drain Backfill," with the following modifications:

1. ~~(a)~~ Trenches shall be excavated to the dimensions and grade required by the plans or as directed.
2. A minimum ~~three (3)-inches (75-millimeters)~~ bedding layer of drain backfill shall be placed in the bottom of the trench for its full width and length.
3. ~~(b)~~ The space below the pipe shall be filled with the required drain backfill throughout its entire length, and brought to a uniform grade.
4. All material excavated from trenches, not suitable for use, shall be removed and disposed of by the Contractor.
5. ~~(c)~~ If an item for grouting drain backfill is shown in the proposal, drain backfill shall be covered with a thick grout not less than ~~one (1)-inch (25-millimeters)~~ in thickness.
  - a. The grout shall be composed of ~~one~~ 1 part Portland cement and ~~five~~ 5 parts sand.
  - b. This grout shall be thoroughly tamped to provide an impervious layer over the entire surface of the drain backfill.

#### 607.03.02 LAYING PIPES

- A. Bell and spigot tile shall be laid upgrade with the bell end upgrade and the spigot end not quite fully entered in the adjacent bell.
  1. Pipe shall be laid true to line and grade with a uniform bearing under the full length of the barrel.
  2. The pipe joints shall then be covered with ~~two~~ 2-ply tar paper strips not less than ~~six (6)-inches (150-millimeters)~~ in width and of sufficient length to permit the ends being turned outward and laid flat on the bottom course of drain backfill on either side for a distance of ~~three (3)-inches (75-millimeters)~~.
- B. Perforated pipe shall be laid with the perforations at bottom of the pipe and the sections joined with band couplers. The pipe shall be firmly bedded throughout its length.

#### 607.03.03 UNDERDRAIN OUTLETS

- A. Trenches for underdrain outlets shall be excavated to the width and depth shown on the plans.
- B. Pipe shall be laid in the trench with all ends firmly joined by the applicable methods and means.
- C. After inspection and approval of the pipe installation, the trench shall be backfilled with structure backfill material in layers and compacted as provided in Section 209, "Drain Backfill."

#### 607.03.04 BLIND DRAINS

- A. Trenches for blind drains shall be excavated to the width and depth shown on plans, or established by the Engineer.
- B. The trench shall be filled with drain backfill material to the depth required by the plans.
- C. Any remaining upper portion of trench shall be filled with either granular or impervious material as may be specified.

## UNDERDRAINS

607

## METHOD OF MEASUREMENT

**607.04.01 MEASUREMENT**

- A. The materials to be measured for payment under these specifications will be listed in the contract items by size, class, type of gauge, or whatever information is necessary for identification.
- B. The quantity of underdrain pipe measured for payment will be the actual number of linear feet ~~(meters)~~ of pipe completed and in place. Underdrain pipe bends, wyes, tees, and other branches will be measured along center lines to the point of intersection.
- C. The quantity of grouted drain backfill measured for payment will be the number of linear feet ~~(meters)~~ of drain grouted, measured along the longitudinal axis of the drain, in the completed work.
- D. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**607.05.01 PAYMENT**

- A. The accepted quantities of underdrain pipe measured as specified in Subsection 607.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~ for the types and sizes specified.
- B. The accepted quantity of grouted drain backfill measured as provided in Subsection 607.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~ for "Grouting Drain Backfill."
- C. Structure excavation and drain backfill will be measured and paid for as separate items as provided in Sections 206, "Structure Excavation," and Section 209, "Drain Backfill."
- D. Provisions for handling of whatever water may be encountered, at the site, shall be an obligation of the Contractor and payment thereof shall be considered ~~as~~ subsidiary to the items involved and no further compensation will be allowed therefor.
- E. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- F. Payment will be made under:

**PAY ITEM****PAY UNIT**

(Size) Perforated Corrugated Metal Pipe for Underdrains (type) .....	Linear Foot <del>(Meter)</del>
(Size) Nonperforated Corrugated Metal Pipe for Underdrains (type) .....	Linear Foot <del>(Meter)</del>
Perforated Concrete Pipe for Underdrains (type) .....	Linear Foot <del>(Meter)</del>
(Size) Clay Pipe for Underdrains (type) .....	Linear Foot <del>(Meter)</del>
Grouting Drain Backfill (width) .....	Linear Foot <del>(Meter)</del>

**SECTION 608****DOWNDRAINS****DESCRIPTION****608.01.01 GENERAL**

- A. This work shall consist of furnishing and installing embankment protectors, flume downdrains, anchor assemblies, slip joints, and bituminous concrete downdrains to collect and carry surface drainage down the roadway slopes.

**MATERIALS****608.02.01 GENERAL**

- A. The materials used shall be those specified~~prescribed or used~~ for the ~~several items which constitute the~~ finished work and shall conform to ~~the requirements of~~ the following sections and subsections:

<b>Materials</b>	<b><u>Section/Subsection</u></b>
Corrugated Metal Pipe for Downdrains	709.03.04 <u>7</u>
Surfacing Miscellaneous Areas	401.03.14 <u>6</u>
Grouted Riprap	610.03.04
Concrete	501
Reinforcing Steel	505
Frames for Grates	609

- B. Pipe for crossbars shall be unpainted standard weight black pipe conforming to ~~the requirements of~~ ASTM ~~Designation~~ A-53 or ASTM A-120.
- C. Downdrains metal products shall be fabricated in accordance with the details and dimensions shown on the plans, except that minor variations may be accepted at the discretion of the Engineer to permit the use of manufacturer's standard jigs and templates in the fabrication. Metal shall not be less than the gauge shown on the plans.
- D. Corrugated metal parts with damaged spelter coating shall be repaired in accordance with Subsection 604.02.01 ~~of Section 604, "Corrugated Metal Pipe~~ General."

**CONSTRUCTION****608.03.01 METAL DOWNDRAINS**

- A. The embankment protector outlet pipe shall be connected to a downdrain pipe of the dimensions shown on the plans by means of a band coupler or a slip joint.
- B. Embankment protectors shall be installed at an outside edge of the embankment gutters or in the shoulder dikes to carry drainage from the roadbed down the embankment slopes to protect the slopes and shoulders from erosion.
1. The entrance device shall be ~~so~~ installed ~~as~~ to prevent water from percolating around the structure and care shall be taken to prevent the structure from being undermined.
  2. The seal between the structure and the surrounding earth shall be made watertight.

3. The embankment protectors shall be placed ~~in such a manner~~so that the lower edge of the opening will be from ~~three (3) inches (7.6 centimeters)~~ to ~~six (6) inches (15.2 centimeters)~~ below the bottom of the gutter flow lines.

#### 608.03.02 BITUMINOUS MIXTURES AND GROUTED RIPRAP

- A. Bituminous mixture and grouted riprap downdrains, when called for, shall be placed in accordance with the provisions in Subsection 401.03.164, "Surfacing Miscellaneous Areas," or Subsection 610.03.04, "Grouted Riprap."

#### METHOD OF MEASUREMENT

#### 608.04.01 MEASUREMENT

- A. The materials to be measured for payment under these specifications will be listed in the contract item by size, type, ~~etc and so forth~~, or whatever information is necessary for identification.
- B. The quantity of embankment protectors, slip joints, and anchor assemblies will be measured as units complete and in place.
- C. Type -1 and 3 embankment protectors shall include the length of the tapered section and the length of tail pipe shown on the plans and this length of tail pipe will not be measured as downdrain pipe.
- D. Type -2 embankment protectors shall include the length of tapered section and a ~~five (5) inch (12.7 centimeters)~~ flume stub and ~~said the~~ stub will not be measured as flume downdrain.
- E. An anchor assembly shall consist of pipe stakes, rods, and hardware for fastening downdrain pipe or flume downdrain as shown on the plans. For payment purposes, a flume downdrain anchor assembly shall include ~~two~~ 2 pipe stakes with necessary clip brackets and bolts.
- F. The quantity of corrugated metal pipe downdrains measured for payment will be the number of linear feet ~~(meters)~~ complete and in place, exclusive of the length of tail pipe to the entrance taper as provided above for entrance tapers.
  1. Pipe placed in excess of the length designated will not be measured for payment unless pipes are cut to fit a structure or slope.
  2. When pipes are cut to fit a structure or slope, the quantity to be paid for will be the length of pipe necessary to be placed before cutting, measured in even ~~two (2) foot (60 centimeters)~~ increments.
- G. Type -4 embankment protectors shall be measured as units complete in place as shown on the plans and as approved by the Engineer, except corrugated metal pipe downdrain shall be measured for payment including the length of pipe stub in the Type -4 embankment protector.
- H. The quantity of elbows, wyes, tees, and other branches measured for payment will be the number of linear feet ~~(meters)~~ for the size and type of pipe involved, complete and in place. Wyes, elbows, tees, and other branches will be measured along centerlines to the point of intersection.
- I. The quantity of corrugated metal flume downdrain measured for payment will be the number of linear feet ~~(meters)~~ complete and in place.



## DOWNDRAINS

608

- J. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**608.05.01 PAYMENT**

- A. The accepted quantities of embankment protectors, slip joints, and anchor assemblies measured as specified in Subsection 608.04.01, "Measurement," will be paid at the contract unit price bid per each for the types and sizes specified.
- B. The accepted quantities of downdrain pipe or downdrain flume, measured as specified in Subsection 608.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~ for downdrain pipe or flume for the types and sizes specified.
- C. Payment for structure excavation and structure backfill will be considered subsidiary to the items of embankment protectors and downdrain pipe or flume and no further compensation will be allowed therefore.
- D. Plantmix bituminous mixture used in downdrains will be paid for as provided in Section 401, "Plantmix Bituminous Pavements – General."
1. The cost incurred for preparing the ditch and all incidentals not specifically mentioned herein will be paid for on a square yard ~~(square meter)~~ basis as provided in Section 402, "Plantmix Bituminous Surface."
  2. Drainage excavation will not be paid for on plantmix bituminous downdrains.
- E. Quantities of grouted riprap placed for downdrains will be paid for according to the provisions of Section 610, "~~Riprap~~ Slope and Channel Protection."
- F. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- G. Payment will be made under:

**PAY ITEM****PAY UNIT**

Embankment Protector (type).....	Each
Slip Joints .....	Each
Anchor Assembly .....	Each
(Size) Downdrain Pipe (type).....	Linear Foot <del>(Meter)</del>
Downdrain Flume.....	Linear Foot <del>(Meter)</del>

**SECTION 609****CATCH BASINS, MANHOLES, AND INLETS****DESCRIPTION****609.01.01 GENERAL**

- A. This work shall consist of constructing or reconstructing catch basins, manholes, inlets, and similar structures, consisting of Portland cement concrete with necessary reinforcement, metal frames, grates, and lids, including required excavation and backfilling.

**MATERIALS****609.02.01 GENERAL**

- A. Materials shall conform to ~~the requirements specified in~~ the following sections and subsections:

<b>Materials</b>	<b>Section/Subsection</b>
Portland Cement Concrete	501
Reinforcing Steel	505
Miscellaneous Metals	712
Gray Iron Castings	712.03.02

- B. Casting shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting strength and value for the service intended.
1. Casting shall be boldly ~~filleted~~filleted at angles and the arises shall be sharp and perfect.
  2. Casting shall be sand blasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.
- C. The Contractor shall obtain from the fabricator of the structural steel grates, frames, and gray iron castings a Certificate of Compliance stating that the fabrications meet ~~the requirements of~~ these specifications, and giving certified shop weights for the fabrications.
- D. Mortar for setting grates shall be mixed in the proportions of ~~one~~1 part cement to ~~three~~3 parts of fine aggregate.
- E. Pipe crossbars for drop inlets shall be unpainted standard weight black pipe conforming to ~~the requirements of~~ ASTM Designation A-53 or A-120. Straps shall be unpainted ASTM A-36 steel.

**CONSTRUCTION****609.03.01 GENERAL**

- A. Catch basins, inlets, and manholes shall be constructed in accordance with ~~all of the requirements of~~ Section 501, "Portland Cement Concrete."
- B. Inlet and outlet pipes shall be placed prior to pouring concrete.

609

## CATCH BASINS, MANHOLES, AND INLETS

- C. Grates shall be set in full mortar beds or otherwise secured as shown on the plans. Grates shall be set accurately to the final elevations so that no subsequent adjustments will be necessary.
- D. Concrete covers, when indicated on the plans, shall be constructed ~~in such manner that they to will~~ fit snugly and be readily removable.
- E. Structural steel grates shall be painted as specified in Section 614, "Painting."
- F. Pipe or tile placed in masonry for inlet or outlet connections shall extend through the walls and beyond the outside surfaces of the walls a sufficient distance to allow for connections with conduit, and the masonry shall be carefully constructed around the pipe or tile ~~m so as~~ to prevent leakage around their outer surfaces.
- G. Commercially prefabricated frames and grates of equal or greater capacity and strength may be substituted for the design shown on the plans for drop inlets provided prior approval is obtained in writing from the Engineer.
- H. Frames and grates shall be matchmarked in pairs before delivery to the work and grates shall fit into their ~~if~~ frames without rocking.

**609.03.02 ADJUSTING CATCH BASIN, MANHOLE, AND INLET COVERS**

- A. Unless otherwise provided on the plans or by the contract, existing covers, including frames, grates, ~~and~~ lids shall be adjusted to the required elevation.
- B. ~~by r~~ Removing such the existing covers and ~~adjusting~~ the top of the existing structures by removing or adding concrete, brick masonry, concrete block masonry, ~~or~~ high density polyethylene adaptor rings, or ~~by using~~ steel or cast iron adaptor rings, as applicable the ~~case may be,~~
- C. ~~r~~ Reinstalling the fixtures by supporting them on a satisfactory collar of concrete constructed ~~as to hold the m~~ fixtures firmly in place.

**609.03.03 CLEAN OUT**

- A. All catch basins, manholes, inlets, and similar structures shall be thoroughly cleaned of any accumulations of silt, debris, or foreign matter of any kind, and shall be clean of ~~such~~ accumulations at the time of final inspection.

**609.03.04 EARTHWORK**

- A. Structure excavation and structure backfill shall conform to ~~the requirements of~~ Section 206, "Structure Excavation" and Section 207, "Structure Backfill."

## METHOD OF MEASUREMENT

**609.04.01 MEASUREMENT**

- A. The quantities of castings and structural steel grates measured for payment will be the number of pounds ~~(kilograms)~~ complete and in place.
  - 1. The weight of castings shall be computed from the dimensions shown on the approved shop drawings, assuming the cast iron to weigh ~~four hundred fifty (450.)~~ pounds per cubic foot ~~(7.2 grams per cubic centimeter)~~, with an allowance of ~~ten (10.)~~ percent for fillets and overrun.

## CATCH BASINS, MANHOLES, AND INLETS

609

2. The weight of structural steel grates shall be computed from the dimensions shown on the approved shop drawings, and in accordance with Section 506, "Steel Structures."
  3. Certified shop weights will be acceptable in lieu of computed weights.
- B. Adjusting covers for catch basins, manholes, and inlets will be measured per each complete and in place.
  - C. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."
  - D. Pipe crossbars and straps for drop inlets shall be included in the measurement for payment by the contract bid price per pound ~~(kilogram)~~ for Structural Steel Grates.

## BASIS OF PAYMENT

**609.05.01 PAYMENT**

- A. The accepted quantities of grates measured as provided in Subsection 609.04.01, "Measurement," will be paid for at the contract unit price bid per pound ~~(kilogram)~~ for types and sizes specified.
- B. The work for adjusting covers measured as specified in Subsection 609.04.01, "Measurement," will be paid for at the contract unit price bid per each for adjusting covers for catch basins, manholes, and inlets, which ~~price~~ shall be full compensation for furnishing all materials, tools, incidentals, and labor required to adjust the covers.
- C. Portland cement concrete used in new structures of catch basins and inlets will be paid for as specified in Section 502, "Concrete Structures."
- D. Reinforcing steel in catch basins and inlets will be paid for as specified in Section 505, "Reinforcing Steel."
- E. The accepted quantity of precast manholes measured as provided in Subsection 609.04.01, "Measurement," will be paid for at the contract unit price bid per each for types and sizes specified. This price shall be full compensation for furnishing all materials including structure excavation and structure backfill, Portland cement concrete, steel, castings, and incidentals necessary to complete the work.
- F. Structure excavation and structure backfill for catch basins and inlets will be paid for as specified in Section 206, "Structure Excavation," and Section 207, "Structure Backfill."
- G. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- H. Payment will be made under:

**PAY ITEM****PAY UNIT**

Castings .....	Pound <del>(Kilogram)</del>
Structural Steel Grates .....	Pound <del>(Kilogram)</del>
(Size) Precast Reinforced Concrete Manhole (type) .....	Each
Adjusting Covers .....	Each

**SECTION 610****SLOPE AND CHANNEL PROTECTION****DESCRIPTION****610.01.01 GENERAL**

- A. This work shall consist of constructing slope and channel protection structures to the lines and grades established by the Engineer using riprap or wire mesh gabions in accordance with the design shown on the plans and these specifications.
- B. Riprap construction shall consist of furnishing and placing riprap (with or without grout), or sacked Portland cement concrete riprap, ~~as the case may be.~~
- C. Wire mesh gabion construction shall consist of furnishing, assembling, tying, and filling open mesh wire baskets with stone.

**MATERIALS****610.02.01 GENERAL**

- A. All materials shall conform to ~~the requirements specified in~~ the following sections and subsections:

<b>Materials</b>	<b>Section/Subsection</b>
Water	722
<del>Stone for Masonry and Riprap</del>	<del>706.03.05</del>
Portland Cement	701
Grout and Mortar Sand	706.03.04
<u>Riprap Grout</u>	<u>706.03.05</u>

- B. When so provided and with prior approval of the ~~e~~Engineer, crushed concrete may be substituted for the above designated stone. In such a case, the concrete shall be sound and meet all requirements as specified for stone.

**610.02.02 GROUT**

- A. Grout shall be composed of ~~one~~ 1 part by volume of Portland cement and ~~three~~ 3 parts by volume of sand and shall be of such consistency that it will fill all voids in the riprap.
- B. Comply with Subsection 706.03.05, "Riprap Grout."

**610.02.03 SACKED CONCRETE**

- A. Sacked concrete shall be composed of sacks filled with Portland cement concrete.
  - 1. The mixed concrete shall contain a minimum of ~~three hundred seventy-six (376)~~ pounds (~~170 kilograms~~) (~~four~~ 4 sacks) of Portland cement per cubic yard.
  - 2. The amount of water added at the time of mixing shall be such as will produce a mixture with a slump of from ~~three (3)~~ inches (~~75 millimeters~~) to ~~five (5)~~ inches.
- B. Unless otherwise provided in the ~~s~~Special ~~p~~Provisions, aggregate for use in sacked concrete riprap shall consist of river run material of a sandy, gravelly nature, clean and free from roots, vegetable matter, and other deleterious substances. When tested on laboratory sieves, river run material shall conform to the following ~~grading~~ gradation requirements.

610

## SLOPE AND CHANNEL PROTECTION

1. Passing a 2-inch ~~(50 millimeters)~~ Ssieve: 80 to 100-Ppercent.
  2. Passing a No. -200 Ssieve: 0 to 4-Ppercent
- C. Sacks for concrete riprap shall be made of at least 10-ounce ~~(285 gram)~~ burlap, and shall be approximately 19-1/2 inches xby 36-inches ~~(495 x 915 millimeters)~~ measured inside the seams when the sack is laid flat.
1. The capacity of each sack shall be approximately 1.25-cubic feet ~~(35 liters)~~.
  2. Sound reclaimed sacks may be used.

**610.02.04 STONES FOR RIPRAP**

- A. Stones used for riprap shall be hard, durable, angular in shape, resistant to weathering and erosion, and free from spoils, cracks, and organic matter.
1. The stone for non-grouted riprap shall have a minimum of 2 fractured faces with neither width nor thickness of a single stone less than ~~one-third~~ 1/3 its length.
  2. The specific gravity of the riprap shall not be less than 2.45.
  3. The nominal stone size shall be as follows:

**Minimum (inches) RIPRAP GRADATIONS**

<u>Percent Passing By Mass</u>	<u>Riprap D50=12" (Inches)</u>	<u>Heavy Riprap D50=18" (Inches)</u>
<u>100</u>	<del>D15</del> <u>20</u>	<del>6</del> <u>30</u>
<u>70-85</u>	<del>D50</del> <u>18</u>	<del>12</del> <u>27</u>
<u>35-50</u>	<del>D85</del> <u>12</u>	<del>18</del> <u>18</u>
<u>5-15</u>	<u>5</u>	<u>7</u>
<u>0</u>	<del>D15</del> <u>2</u>	<del>9</del> <u>3</u>
	<del>D50</del>	<del>18</del>
	<del>D85</del>	<del>24</del>

- B. This stone shall conform to the following requirements:

<b>Source Requirements</b> <u>Test</u>	<b>Test Method</b>	<b>Requirements</b>
Percent of Wear <u>(500 Rev.)</u>	ASTM C- <del>535</del> <u>131</u>	45% Maximum
Bulk Specific Gravity	ASTM C-127	2.5 Minimum

- C. Control of gradation will be by visual inspection.
1. Upon request by the Engineer, the Contractor shall provide a sample of stone of at least 5-tons ~~(4.54 metric tons)~~ meeting the gradation for each location riprap is indicated.
  2. Each sample shall be located at the construction site near the location where the riprap is to be placed.
  3. The sample shall be used as a frequent reference for judging the gradation of the riprap supplied.
  4. The sample riprap shall be in place and acceptable to the Engineer before riprap placing work begins.

## SLOPE AND CHANNEL PROTECTION

610

5. The Contractor shall maintain the placed riprap until the project is completed and any material displaced by any cause shall be repaired to the lines and grades indicated on the plans.
- D. Caliche stone or cementitious materials meeting the requirements of this section may be used as riprap with prior approval of the Engineer.
  1. The riprap shall be fully cemented material. Only materials designated as hard (scratches leave only dust, requires many hammer blows to break) or very hard (difficult to scratch or break) shall be utilized.
  2. Moderately hard (crumbles with several hammer blows) or partially cemented materials are not acceptable.
- E. The Contractor may be required to provide riprap test results from an approved testing laboratory and a Certificate of Compliance in accordance with Subsection 106.05, "Certificate of Compliance."

**610.02.05 STONES FOR GABIONS**

- A. Stones for filling the gabions shall be well graded, hard stones, conforming to the testing requirements specified in Subsection 706.03.05 610.02.04, "Stones for ~~Masonry and~~ Riprap."
- B. Size and gradation shall be such that the predominant size is between 4 inches ~~to~~ and 8 inches ~~(100 to 200 millimeters), eighty-five~~ 85 percent by weight.
  1. Minimum stone dimensions shall be 3 inches ~~(75 millimeters)~~ and maximum stone dimension shall be 8 inches ~~(200 millimeters)~~.
  2. For gabion baskets less than 1 foot ~~(0.3 meters)~~ in height, the maximum stone dimension shall be 6 inches ~~(150 millimeters)~~.

**610.02.06 FILTER MATERIAL**

- A. When filter material is specified or shown on the plans, the material shall consist of mineral aggregate that is clean, hard, durable, and free of any deleterious matter or harmful adherent coatings.
- B. Gradation of the filter material shall conform to the requirements specified by the Engineer, or as shown in the ~~s~~ Special ~~p~~ Provisions.

**610.02.07 FILTER FABRIC**

- A. When filter fabric is specified or shown on the plans, the fabric shall consist of a geotextile that is made from synthetic fibers.
- B. The filter fabric shall be in accordance with ~~the requirements of~~ AASHTO M288, Section A4, and shall conform to the requirements specified by the Engineer.

**610.02.08 WIRE MESH GABIONS AND GABION MATTRESSES**

- A. Wire mesh gabions and gabion mattresses shall be fabricated from either twisted wire mesh or welded wire mesh.
  1. All wires shall be galvanized prior to fabricating the mesh and in compliance with ASTM A90.
  2. Only ~~one~~ 1 type of wire mesh may be used in any ~~one~~ 1 structure.

- B. Gabion and gabion mattress dimensions of width, height, and length shall be as shown on the plans.
1. Each gabion unit shall not vary more than ~~five~~ 5 percent from the dimensions shown on the plans.
  2. Gabions come 1-foot ~~(0.3-meter)~~ or greater in height, 3-~~feet~~ feet in width, and ~~they~~ are compartmentalized into cells not larger than 3-~~feet~~ feet ~~(0.9-meter)~~ ~~Xby~~ 3-~~feet~~ feet ~~(0.9-meter)~~ by attaching to the base single diaphragm panels made of the same type and size mesh as the gabion panels.
  3. Gabion mattresses come 9-inches ~~(0.23-meter)~~ or less in height, 6-~~feet~~ feet in width, and ~~they~~ are compartmentalized into cells not larger than 6-~~feet~~ feet ~~(1.83-meter)~~ ~~Xby~~ 3-~~feet~~ feet ~~(0.9-meter)~~ by attaching to the base single diaphragm panels made of the same type and size mesh as the gabion mattress panels.
- C. The baskets shall be assembled with the necessary panels and diaphragms secured to the base in accordance with ASTM A975-97, Table 2 requirements. Pleating the base panel to obtain the diaphragms is prohibited.
- D. Fabrication of the wire mesh gabions and gabion mattresses shall be as follows:
1. ~~(a)~~ Twisted Wire Mesh Gabions and Gabion Mattresses:
    - a. Gabion panels for the twisted mesh style shall be manufactured from galvanized steel wire, Class 3, soft temper, conforming to ASTM A641, or from aluminized steel wire, soft temper, conforming to ASTM A809.
      - 1) The wire shall have a minimum tensile strength of 60,000 psi ~~(415-MPa)~~ when tested in accordance with ASTM A370.
      - 2) Twisted wire mesh gabions and gabion mattresses shall comply with ASTM A975-97 standards.
    - b. The mesh shall be formed with non-raveling double twists by twisting each pair of wires through two 360-degree turns. The mesh openings shall be hexagonal in shape and uniform in size and shall comply with the mesh dimensions and requirements shown on Table -1 and Table -2 below.
    - c. All perimeter edges of the mesh panels forming the gabion basket shall be securely tied to a selvedge wire so that the selvedge to-mesh connection has at least the same strength as the body of the mesh. Selvedge wire shall be the same kind and type of material used for the mesh, except that ~~the~~ wire diameters shall be as shown on the tables below.
    - d. When specified by the Engineer, the galvanized or aluminized wire shall be coated with a polyvinyl chloride (PVC) material. The coating shall be accomplished by using either extruded or extruded and bonded PVC material, and shall be applied before twisting the wire into mesh panels.
    - e. All wire used for twisted mesh gabions and gabion mattresses shall meet the following nominal requirements:



<b>Table 1 - Nominal Requirements for Twisted Wire Mesh Gabions</b>			
Type of Basket	Mesh Size	Mesh Wire	Selvedge Wire
Baskets 1-foot <del>(0.3 meter)</del> or greater in height	3.25-inch <del>X</del> by 4.5-inch <del>(82.5 mm X 114 mm)</del>	0.120-inch <del>(3.05 mm)</del>	0.148-inch <del>(3.76 mm)</del>
Baskets 1-foot <del>(0.3 meter)</del> or greater in height with PVC coating	3.25-inch <del>X</del> by 4.5-inch <del>(82.5 mm X 114 mm)</del>	0.106-inch <del>(2.69 mm)</del> , plus the PVC coating	0.134-inch <del>(3.40 mm)</del> , plus the PVC coating

<b>Table 2 - Nominal Requirements for Twisted Wire Mesh Gabion Mattresses</b>			
Type of Basket	Mesh Size	Mesh Wire	Selvedge Wire
Baskets 9-inches <del>(0.23 meter)</del> or less in height	2.5-inch <del>X</del> by 3.25-inch <del>(63.5 mm X 82.5 mm)</del>	0.087-inch <del>(2.21 mm)</del>	0.106-inch <del>(2.69 mm)</del>
Baskets 9-inches <del>(0.23 meter)</del> or less in height with PVC coating	2.5-inch <del>X</del> by 3.25-inch <del>(63.5 mm X 82.5 mm)</del>	0.087-inch <del>(2.21 mm)</del> , plus the PVC coating	0.106-inch <del>(2.69 mm)</del> , plus the PVC coating

2. ~~(b)~~ Welded Wire Mesh Gabions and Gabion Mattresses:

- a. Gabion panels for the welded mesh style shall be manufactured from welded wire fabric conforming to ASTM ~~-~~A185 and ASTM ~~-~~A974-97, Type ~~-~~1.
- b. Galvanized wire shall have a Class ~~-~~3 coating as indicated in ASTM ~~-~~A641.
- c. Aluminized wire shall have a minimum coating as indicated in ASTM ~~-~~A809.
- d. The wire shall be soft tempered with a minimum tensile strength of 60,000-psi ~~(415 MPa)~~ when tested in accordance with ASTM ~~-~~A370.
- e. Welded wire mesh gabions and gabion mattresses shall comply with ASTM ~~-~~A974-97 standards.
- f. The mesh shall form a square or rectangular grid pattern with the maximum diagonal dimension of any grid opening not to exceed 4.5-inches ~~(114 millimeters)~~.
- g. The welded wire mesh shall be galvanized or aluminized prior to welding into mesh and shall comply with the dimensions and requirements shown on Table ~~-~~3 and Table ~~-~~4 below.
- h. When specified by the Engineer, the welded wire mesh shall be coated with a polyvinyl chloride material. The PVC coating shall be fusion bonded to the galvanized or aluminized wire after fabrication of the gabion mesh panels.
- i. All wire used for welded mesh gabions and gabion mattresses shall meet the following nominal requirements:

<b>Table 3 - Nominal Requirements for Welded Wire Mesh Gabions</b>		
Type of Basket	Mesh Size	Mesh Wire
Baskets 1-foot <del>(0.3 meter)</del> or greater in height	3-inch <del>X</del> by 3-inch <del>(76 mm X 76 mm)</del>	0.120-inch <del>(3.05 mm)</del>
Baskets 1-foot <del>(0.3 meter)</del> or greater in height with PVC coating	3-inch <del>X</del> by 3-inch <del>(76 mm X 76 mm)</del> , plus the PVC coating	0.106-inch <del>(2.69 mm)</del> , plus the PVC coating

Table 4 - Nominal Requirements for Welded Wire Mesh Gabion Mattresses		
Type of Basket	Mesh Size	Mesh Wire
Baskets 9 inches <del>(0.23-meter)</del> or less in height	1.5-inch <del>X</del> by 3-inch <del>(38-mm X 76-mm)</del>	0.087 inch (2.21 mm)
Baskets 9 inches <del>(0.23-meter)</del> or less in height with PVC coating	1.5-inch <del>X</del> by 3-inch <del>(38-mm X 76-mm)</del> , plus the PVC coating	0.087-inch <del>(2.21-mm)</del> , plus the PVC coating

- j. For polyvinyl chloride coated either twisted or welded mesh gabions and gabion mattresses, the PVC coating shall have a nominal thickness of 0.020-inch ~~(0.51-mm)~~ and a minimum thickness of 0.015-inch ~~(0.38-mm)~~. The coating shall be grey, silver, green, or black and conform to the following:
- 1) ~~(a)~~—Specific Gravity: In the range of 1.20 to 1.40, ASTM-D-792.
  - 2) ~~(b)~~—Abrasion Resistance: The percentage of weight loss shall be less than 12-percent, when tested according to ASTM-D-1242, Method-B at 200-cycles, CSI-A Abrader Tape, 80-Grit.
  - 3) ~~(c)~~—Brittleness Temperature: Not higher than 15-degrees-F, ASTM-D-746.
  - 4) ~~(d)~~—Tensile Strength: Extruded Coating - Not less than 2,980-psi, ASTM-D-412. Fusion Bonded Coating - Not less than 2,275-psi, ASTM-D-638.
  - 5) ~~(e)~~—Modulus of Elasticity: Extruded Coating - Not less than 2,700-psi, at 100-percent strain, ASTM-D-412. Fusion Bonded Coating - Not less than 1,980-psi. at 100-percent strain, ASTM-D-638.
  - 6) ~~(f)~~Ultraviolet Light Exposure: A test period of not less than 3,000-hours, using apparatus ~~f~~Type-E at ~~145.463-degrees-F~~C, ASTM-G23.
  - 7) ~~(g)~~—Salt Spray Test: A test period of not less than 3,000-hours, ASTM-B-117.

#### 610.02.09 INTERNAL CONNECTING WIRES

- A. Internal connecting wires to reinforce the side panels of individual gabion baskets shall meet the same specifications as the wire used in the gabion body, except ~~its~~ wire nominal diameter shall be 0.087-inches ~~(2.21-millimeters)~~ or larger. Alternate preformed stiffeners acceptable to the gabion Manufacturer and the Engineer may also be used.

#### 610.02.10 LACING WIRE

- A. Lacing wire to assemble, interconnect, and close the gabion baskets shall meet the same specifications, as the wire used in the gabion body except its nominal diameter shall be 0.087-inches ~~(2.21-millimeters)~~.

#### 610.02.11 WIRE FASTENERS

- A. Machine formed spiral wire binders with a 3-inch ~~(76-mm)~~ pitch and 2.5-inch ~~(64-mm)~~ I.D. inside diameter maximum are the standard fastener for welded wire mesh gabions and gabion mattresses, and shall be formed from wire meeting the same quality and coating thickness requirements as specified above for the gabions and gabion mattresses.

## SLOPE AND CHANNEL PROTECTION

610

- B. As an alternative to lacing wire and spiral binders, wire fasteners including interim fasteners, interlocking ring fasteners, overlapping (hog) ring fasteners, and twist ties may be used, subject to the approval of the Engineer.
- C. The Contractor shall demonstrate that:
- ~~(a)~~ The proposed fastener can consistently resist an opposed tension force of at least 600 pounds ~~(2.7 kilonewtons)~~ without pulling apart.
  - ~~(b)~~ The proposed fastener system can consistently produce a joint with strength of at least 1,400 pounds per lineal foot ~~(20.4 kilonewtons per lineal meter)~~ while encompassing the number of wires as intended for its use. When PVC coated wire is used, the joint strength shall be at least 1,200 pounds per lineal foot ~~(17.5 kilonewtons per lineal meter)~~.
  - ~~(c)~~ The proposed fastener system does not cause damage to the protective coating on the wire.
  - ~~(d)~~ The Contractor has the proper equipment and trained employees to correctly install the fasteners.
  - ~~(e)~~ Proper installation can be readily verified by visual inspection.
- D. The Contractor shall provide a complete description of the fastener system, including the number of fasteners required, the number and size of wires that the fastener is capable of properly joining, and a description of a properly installed fastener, including drawings or photographs, if necessary.
- E. Properly formed fasteners shall meet the following requirements:
- ~~(a)~~ Each interlocking fastener shall be locked and closed.
  - ~~(b)~~ Each overlapping ring fastener shall be closed and the free ends shall overlap a minimum of ~~one (1) inch (25 millimeters)~~.
  - ~~(c)~~ Spiral binders shall be crimped to secure the spiral in place.
  - ~~(d)~~ Twist ties shall have a minimum of ~~two (2)~~ complete revolutions.
- F. If gauges or other aids are needed to verify the proper installation of the fasteners, the Contractor shall furnish the Engineer ~~such~~the gauges or aids, in ~~such~~ numbers as may reasonably be required.
- If more than ~~one~~1 wire fastener is proposed, e.g. different gauge or length of wire, for different joints, the fasteners shall be readily distinguishable.
  - 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 intervals of 4 inches to 6 inches ~~(100 to 150 millimeters)~~ at the location where mesh wire meets selvedge or edge wire.
- G. Fastener Materials:
- Galvanized wire fasteners shall be used with galvanized gabions.
  - Aluminized wire fasteners shall be used with aluminized gabions.
  - Stainless steel overlapping rings or interlocking rings shall be used for stainless steel gabions.
  - PVC coated wire spiral binders shall be used for PVC coated gabions.

610

## SLOPE AND CHANNEL PROTECTION

H. Fastener Properties:

1. Galvanized wire fasteners, shall conform to ASTM A764 with Type III coating.
2. Aluminized wire fasteners shall conform to ASTM A809 for wire diameter and coating, with tensile strength equal to ASTM A764, Table 2.
3. Stainless steel wire fasteners shall conform to ASTM A313, Grade 302.
4. Spiral binder fasteners shall be formed with wire having at least the same thickness and coating as the basket mesh wire.
5. Twist tie fasteners shall meet the requirements of lacing wire, as specified in Subsection 610.02.10, "Lacing Wire."

## CONSTRUCTION

**610.03.01 EARTHWORK**

- A. The areas where riprap or wire mesh gabions are to be placed shall be graded to the required lines and grades as shown on the plans or as directed by the Engineer.
- B. Any excavations or backfill required to achieve such grade shall conform to the provisions of Section 206, "Structure Excavation," and Section 207, "Structure Backfill."

**610.03.02 FILTER PLACEMENT**

- A. Filter material shall be spread uniformly on the prepared foundation surface in a manner satisfactory to the Engineer, and to the slopes, lines, and grades as shown on the plans, or as specified by the Engineer.
  1. Placing of a filter material by methods, ~~which that~~ will ~~tend to~~ segregate particle sizes, will not be permitted.
  2. Any damage to the foundation surface during filter placement shall be repaired before proceeding with the work.
  3. The filter materials shall be placed and placement shall be ~~repaired~~ approved and accepted before proceeding with the work.
  4. The filter materials shall be placed and finished to present a reasonably even surface free from mounds or windrows.
  5. Compaction of the filter materials shall conform to the requirements shown on the plans or as outlined in the ~~s~~Special ~~p~~Provisions.
- B. Filter fabric shall be installed in accordance with the manufacturer's recommendations, and in manner that will not tear, puncture, or shift the fabric.
- C. Joining edges of the filter fabric shall be overlapped a minimum of 18 inches ~~(450 millimeters)~~.
- D. Filter fabric placed behind and/or beneath gabion or gabion mattress structures shall have a minimum permeability of 0.15 inch/second ~~(0.38 cm/sec)~~ and shall be designed to retain the fine particles of the subsoil, while releasing any hydrostatic pressure buildup.

**610.03.03 RIPRAP**

- A. Stone for riprap shall be placed in a manner ~~which that~~ will produce a well-graded mass of stone with a minimum percentage of voids.

## SLOPE AND CHANNEL PROTECTION

610

1. The entire mass of stone shall be placed in conformance with the lines, grades, and thicknesses shown on the plans.
  2. Riprap shall be placed to its course thickness in ~~one~~1 operation and in such a manner as to avoid displacing underlying material.
  3. When filter fabric is used under the riprap, the height from which the stone is dropped shall be minimized to avoid fabric damage.
  4. Placement of stones shall begin at the bottom of the slope and proceed upward to the top.
- B. The large stones shall be well distributed and the entire mass of stone shall conform to the gradation specified.
1. All material placed as riprap protection shall be so placed and distributed that there is no large accumulation of either the larger or smaller sizes of stone.
  2. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation will not be permitted.

**610.03.04 GROUTED RIPRAP**

- A. When grouted riprap is specified, the stone shall be laid as set forth above for riprap.
- B. The spaces between the stones shall then be filled with grout as ~~designed~~directed, and in accordance with Subsection -706.03.05, "~~Aggregates for Portland Cement Products~~Riprap Grout."
- C. Sufficient grout shall be used to completely fill all voids, except that the face surface of the stone shall be left exposed.
- D. After grouting is completed, the surface shall be cured as specified in Section -502, "Concrete Structures" for a period of at least ~~three~~(3) days.

**610.03.05 SACKED CONCRETE RIPRAP**

- A. The sacks shall be filled with concrete, loosely placed, with~~so as to leave~~ enough room ~~left for folding~~ at the top to; ~~the fold to be just enough~~ to retain the concrete at the time of placing.
1. Not more than ~~one~~(1) cubic foot ~~(28 liters)~~ of concrete shall be placed in each sack.
  2. Immediately after being filled with concrete, the sacks shall be placed and lightly trampled to cause them to conform with the earth face and to adjacent sacks in place.
- B. The slopes on which the sacked concrete riprap is to be placed shall be finished true to line and grade.
1. The first course shall consist of a double row of stretchers laid in a neatly trimmed trench, ~~and~~
  2. ~~The~~the second course shall consist of a single row of headers.
  3. The third and remaining courses shall consist of stretchers.
  4. ~~They~~Courses shall be placed in such a manner that joints in succeeding courses are staggered.

610

## SLOPE AND CHANNEL PROTECTION

5. All dirt and debris shall be removed from the top of the sacks before the next course is laid thereon.
  6. Stretchers shall be placed so that the folded ends will not be adjacent.
  7. Headers shall be placed with the folds toward the earth face.
  8. Not more than ~~four~~ 4 vertical courses of sacks shall be placed in any tier until initial set has taken place in the first course of any such tier.
- C. When, in the opinion of the Engineer, there will not be proper bearing or bond for the concrete due to delays for any cause, a small trench shall be excavated back of the row of sacks already in place. The trench shall be filled with fresh concrete before the next layer of sacks is laid.
- D. Sacked concrete riprap shall be cured ~~per~~ in accordance with Section ~~702~~, "Concrete Curing Materials and Admixtures."

**610.03.06 WIRE MESH GABIONS AND GABION MATTRESSES**

- A. Prior to the assembly and placement of the wire mesh gabions, a representative of the gabion manufacturer shall be present at the construction site for ~~one~~ 1 day of placement or construction to demonstrate the method of assembling, interconnecting, stone filling, and closing the gabion, unless otherwise specified in the ~~s~~ Special ~~p~~ Provisions.
- B. Construction of the gabion structure shall not proceed until the Engineer approves the Contractor's assembly and placement methods.
- C. Gabion baskets shall first be assembled as empty units.
1. The panels and diaphragms shall be connected to the base panel, rotated into position, and joined along the edges with lacing wire, spiral binders, or approved wire fasteners.
  2. When joined with lacing wire, the lacing wire shall be tightly looped at intervals of not more than 6 inches (~~150 millimeters~~) along the seams ~~in such a manner~~ so that single and double loops are alternated.
  3. When joined with preformed spiral binders, thread the spirals along the panels' edges through every mesh and crimp the spirals ends to secure them in place.
  4. When joined with alternate fasteners, they ~~fasteners~~ shall be properly installed as specified in Subsection 610.02.11, "Wire Fasteners 3."
  5. For either method, there shall not be any opening greater than 2 inches (~~50 millimeters~~) (maximum line dimension) along the joined edges or at the corner of the gabion basket.
- D. Empty gabion baskets shall be placed into position, over the filter fabric when required, on the prepared foundation.
1. Empty gabion baskets shall be joined successively to the next empty gabion basket before filling with stone.
  2. Each row, tier, ~~or~~ and layer of baskets shall be reasonably straight and shall conform to the line and grade shown on the plans or established by the Engineer.
  3. The empty gabion baskets shall be fastened to the adjacent baskets along the top and vertical edges.
  4. Each layer shall be fastened to the underlying layer along the front, back, and ends.

## SLOPE AND CHANNEL PROTECTION

610

5. Unless otherwise shown on the plans, the vertical joints between basket units of adjacent tiers or layers shall be staggered by at least one cell along the length of the structure.
- E. All fastening of adjacent baskets shall be done with lacing wire, spiral binders, or approved wire fasteners in order to obtain a monolithic structure. The method of fastening shall meet the same requirements as that specified for assembling individual gabion baskets.
- F. Fastening shall be made through selvedge-to-selvedge or selvedge-to-edge wire connection. Mesh-to-mesh or selvedge-to-mesh wire connection is allowed along vertical edges or in the case where baskets are offset or stacked, and selvedge-to-mesh or mesh-to-mesh wire connection would be necessary.
- G. Before filling each gabion basket with stone, tension may be applied to the empty baskets to achieve a uniform alignment and shall be accomplished ~~in such a manner as~~ to prevent any possible unraveling.
  1. Welded wire mesh gabions do not require stretching.
  2. The finished gabion structure shall have no gaps along the perimeter of the contact surfaces between adjoining gabion basket units.
- H. The gabion cells shall be carefully filled with stone placed by hand and/or machine ~~in such a manner so~~ that the alignment of the structure will be maintained ~~so as~~ to avoid bulges and ~~to~~ minimize voids.
  1. All exposed stone surfaces shall have a reasonable smooth and neat appearance.
  2. No sharp stone edges shall project through the wire mesh.
- I. The gabion baskets stone-fill may be either cobbles or crushed stone.
  1. The stone shall be clean, hard, durable, and of suitable quality to ensure suitable performance in the gabions or gabion mattresses.
  2. The stone shall be free from cracks, seams, and other defects that would tend to increase its deterioration in the gabion baskets.
  3. The inclusion of dirt, sand, clay, debris, and rock fines will not be permitted.
  4. Stone-fill used in the gabions and gabion mattresses shall be a well-graded mixture with sizes ranging between 4 inches ~~(0.10 meter)~~ and 8 inches ~~(0.20 meter)~~ in diameter for gabions 1 foot ~~(0.3 meter)~~ or greater in height, and between 3 inches ~~(76 mm)~~ and 6 inches ~~(152 mm)~~ in diameter for gabion mattresses 9 inches ~~(230 mm)~~ or less in height.
- J. The gabion cells in any row or layer shall be filled in stages so that local deformations may be avoided.
  1. At no time shall any cell be filled to a depth exceeding 12 inches ~~(0.3 meter)~~ more than any adjacent cell.
  2. The maximum height from which the stone may be dropped into the basket units shall be 3 feet ~~(0.9 meter)~~.
- K. During filling operations, internal connecting wires shall be placed in all exposed front and side gabion units in the following manner:
  1. ~~(a)~~ For gabion cells with a 36 inch ~~(0.9 meter)~~ height, ~~;~~



610

## SLOPE AND CHANNEL PROTECTION

- a. ~~s~~Stone shall be placed to a depth of ~~one-third~~<sup>1/3</sup>, 12\_-inches ~~(0.3-meter)~~, after which a minimum of ~~two~~<sup>2</sup> equally spaced internal connecting wires shall be placed in each cell, connecting the front and back faces of the compartment.
  - b. For corner units, internal connecting wires shall be placed in both directions.
  - c. The connecting wires shall be looped around ~~two~~<sup>2</sup> twisted wire mesh openings, or a welded wire joint, at each basket face, and the wire terminals shall be securely wrapped to prevent their loosening.
    - 1) This operation shall be repeated when the cell is ~~two-thirds~~<sup>2/3</sup> full.
    - 2) In welded mesh gabions, these cross-ties or stiffeners are made from lacing wire and placed across the corners of the gabion cells at 12\_-inches from the corners, thus providing a diagonal bracing. Lacing wire or preformed hooked wire stiffeners may be used.
2. ~~(b)~~For thinner gabion cells:-
- a. ~~i~~Internal connecting wires are not required except when 18\_-inch ~~(450 millimeter)~~ baskets are used to build exposed vertical surfaces.
  - b. In this case, the procedures under Subparagraph 1.(a) above shall be followed, except that the internal connecting wires shall be placed at 9\_-inches ~~(230 millimeters)~~ from the base.

## METHOD OF MEASUREMENT

## 610.04.01 MEASUREMENT

- A. The quantity of riprap, grouted riprap, and wire mesh gabions measured for payment will be the number of cubic yards ~~(cubic-meters)~~ or square yards ~~(square-meters)~~ complete and in place.
- B. The quantity of sacked concrete riprap to be measured for payment will be the number of cubic yards ~~(cubic-meters)~~ at the mixer or the number of square yards ~~(square-meters)~~ of sacked riprap in the completed work.
- C. Only work placed within the dimensions shown on the plans or ordered by the Engineer, will be measured for payment. All measurements will be made in accordance with Subsection -109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

## 610.05.01 PAYMENT

- A. The accepted quantities of riprap, grouted riprap, sacked concrete riprap, and wire mesh gabions measured as provided in Subsection -610.04.01, "Measurement," will be paid for at the contract unit price bid per cubic yard ~~(per-cubic-meter)~~ or square yard ~~(square-meter)~~ for the type specified, which ~~payment~~ shall be full compensation for furnishing and placing stone, grout, concrete, wire mesh gabions, filter material, filter fabric, and all other miscellaneous items that are appurtenant to the construction of riprap or gabion structures, including the cost incurred for a manufacturer's representative at the construction site. The above prices shall also include all excavation, grading, and backfill necessary to complete the work.
- B. All payments will be made in accordance with Subsection -109.02, "Scope of Payment."



## SLOPE AND CHANNEL PROTECTION

610

C. Payment will be made under:

PAY ITEM	PAY UNIT
Riprap .....	Cubic Yard or Square Yard <del>(Cubic Meter or Square Meter)</del>
Heavy Riprap .....	Cubic Yard or Square Yard <del>(Cubic Meter or Square Meter)</del>
Grouted Riprap .....	Cubic Yard or Square Yard <del>(Cubic Meter or Square Meter)</del>
Sacked Riprap .....	Cubic Yard or Square Yard <del>(Cubic Meter or Square Meter)</del>
Wire Mesh Gabions .....	Cubic Yard or Square Yard <del>(Cubic Meter or Square Meter)</del>

**SECTION 611****CONCRETE SLOPE PAVING****DESCRIPTION****611.01.01 GENERAL**

- A. This work shall consist of constructing concrete slope paving and concrete mortar slope paving including aprons and cutoff walls in connection therewith, to the lines and grades established by the Engineer and in accordance with the design shown on the plans.

**MATERIALS****611.02.01 GENERAL**

- A. Materials shall conform to ~~the requirements specified in~~ the following sections:

<b>Materials</b>	<b>Section</b>
Portland Cement Concrete	501
Reinforcing Steel	505

- B. Concrete mortar slope paving shall consist of a mixture of ~~one (1)~~ part Portland cement to ~~four~~ 4 parts sand, thoroughly mixed in a dry state prior to mixing with water.
1. Measurement may be either by volume or weight.
  2. Before placing, all lumps ~~three eighths (3/8)~~ inch ~~(1 centimeter)~~ or and over shall be removed by screening.
  3. Sand shall conform to ~~the requirements of~~ Subsection 706.03.03, "Fine Aggregate."
  4. An Air-Entaining Admixture shall be added to the Concrete Mortar at a rate of ~~four to seven (4 percent to -7)~~ percent.
- C. Mesh reinforcing for ditch lining and slope paving reinforcement shall be of the sizes shown on the plans, shall be fabricated of cold drawn steel wire, and need not be galvanized. Mesh reinforcing shall conform to ~~the requirements of~~ ASTM A185.
- D. Header boards consisting of ~~2-inch" x by 4-inch" (5 x 10 centimeters)~~ redwood lumber furnished and placed in the concrete or mortar slope paving shall be as shown on the plans. Lumber used in the construction of header boards shall be commercial grade heart redwood, S4S.
- E. Nails used in construction of header boards shall be commercial quality galvanized nails.

**CONSTRUCTION****611.03.01 EARTHWORK**

- A. The subgrade for paved ditches and slope paving shall be formed by excavating to the required depth below the prepared finish surface grade in accordance with dimensions and design indicated on the plans or as directed by the Engineer.
- B. The subgrade shall be thoroughly compacted.

611

## CONCRETE SLOPE PAVING

1. Any soft, spongy, or other unsuitable material shall be removed to ~~such the~~ depth as directed by the Engineer, ~~and~~ backfilled with suitable material, and thoroughly compacted.
  2. Water shall be sprinkled on the subgrade during compaction, ~~and~~
  3. ~~t~~The subgrade shall be sufficiently moist prior to placing concrete or mortar to prevent absorption.
- C. Excavations for trenches, footings, cutoff walls, ~~etc. and so forth~~, shall conform to ~~the requirements of~~ Section 206, "Structure Excavation." Gradation and compaction requirements on structure backfill will not apply.

**611.03.02 GENERAL**

- A. Concrete, after placing, shall be tamped until it is thoroughly consolidated and mortar flushes to the surface.
1. If the slope is too steep to permit the use of concrete sufficiently wet to flush with tamping, the concrete may be tamped until consolidated and a mortar surface ~~one-fourth (1/4) inch (0.6 centimeters)~~ thick troweled on immediately.
  2. The mortar shall consist of ~~one~~ 1 part Portland cement and ~~three~~ 3 parts of clean, sharp sand.
  3. The mortar surface shall be considered as a part of the concrete and no additional allowance will be made therefore.
- B. After striking off to grade, the concrete shall be hand floated with wooden floats not less than ~~four (4) inches (10 centimeters)~~ in width and not less than ~~thirty (30) inches (76 centimeters)~~ in length.
1. Care shall be taken to prevent rotary marks of the hand floats.
  2. The entire surface shall be broomed with a fine texture hair push broom to produce a uniform surface and eliminate float marks.
  3. Brooming shall be done when the surface is sufficiently set to prevent deep scarring and shall be accomplished by drawing the broom down the slope leaving the marks parallel to the edges of the panel.
  4. Joints shall be edged with a ~~one-fourth (1/4) inch (0.6 centimeters)~~ radius edger prior to the brooming.
- C. Materials for mortar that have been mixed for more than 45 minutes and have not been incorporated in the work shall not be used unless otherwise permitted by the Engineer.
- D. Concrete or mortar shall not be placed against frosted or frozen surface. If concrete or mortar is placed during cold weather, it shall be heated and protected during placing and curing as set forth in Section 501, "Portland Cement Concrete," except concrete or mortar shall be maintained at a temperature of not less than 50 degrees F: ~~(10 degrees C.)~~ for 72 hours after placing and at not less than 40 degrees F: ~~(4.4 degrees C.)~~ for an additional ~~four~~ 4 days.
- E. The slope paving shall be constructed without expansion joints.
- F. The mesh reinforcing shall be placed ~~so as to be~~ in the approximate center of the concrete mortar.

## CONCRETE SLOPE PAVING

611

- G. All joints shall be lapped ~~six (6) inches (15 centimeters)~~ and run continuously throughout paving or between headers.
- H. Concrete slope paving, aprons, and cutoff walls shall be cured as specified in Section 502, "Concrete Structures."

## METHOD OF MEASUREMENT

## 611.04.01 MEASUREMENT

- A. The quantity of concrete slope paving or concrete mortar slope paving, including concrete or concrete mortar aprons and cutoff walls, measured for payment will be the number of cubic yards ~~(cubic meters)~~ or square yards ~~(square meters)~~ complete and in place.
1. The quantity will be computed from measurements of the actual areas placed based on the theoretical thickness shown on the plans.
  2. No additional allowance will be made for additional concrete placed ~~by reason of~~ due to low subgrades.
- B. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

## 611.05.01 PAYMENT

- A. The accepted quantities of concrete slope pavement and concrete mortar slope paving as well as aprons and cutoff walls in connection therewith, measured as provided in Subsection 611.04.01, "Measurement," will be paid for at the contract unit price bid per cubic yard ~~(cubic meter)~~ or square yards ~~(square meters)~~ for the material and class specified, which ~~payment~~ shall be full compensation for excavation, backfill, furnishing and installing redwood headers, concrete or mortar, ~~and~~ all labor, tools, equipment, and incidentals, and for doing all the work involved in placing the concrete slope pavement ~~(including subgrade preparation, forms, and curing)~~, complete in place, as shown on the plans, as specified herein, and as directed by the Engineer.
- B. Reinforcement shall be measured and paid for as specified in Section 505, "Reinforcing Steel." ~~of the Standard Specifications.~~
- C. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- D. Payment will be made under:

## PAY ITEM

## PAY UNIT

(Class) Concrete Slope Pavement .....	Cubic Yard <del>(Cubic Meter)</del> or Square Yard <del>(Square Meter)</del>
(Class) Concrete Aprons .....	Cubic Yard <del>(Cubic Meter)</del> or Square Yard <del>(Square Meter)</del>
Concrete Mortar Slope Pavement .....	Cubic Yard <del>(Cubic Meter)</del> or Square Yard <del>(Square Meter)</del>

## SECTION 612

## PNEUMATICALLY PLACED CONCRETE MORTAR

~~01~~DESCRIPTION

## 612.01.01 GENERAL

- A. This work shall consist of lining ditches and channels, slope paving, and constructing warped sections and other similar features with mortar pneumatically placed in accordance with these specifications and the ~~s~~Special ~~p~~Provisions.
- B. Pneumatically placed mortar shall consist of either dry mixed fine aggregate and Portland cement applied by a suitable mechanism, to which mixture the water is added immediately previous to its expulsion from the nozzle, or mortar pre-mixed by mechanical methods and pneumatically applied through a nozzle onto the prepared foundation.

~~02~~MATERIALS

## 612.02.01 GENERAL

- A. The materials used shall be those prescribed for the several items which constitute the finished work and shall conform ~~with to~~ all the requirements for ~~such the~~ materials as set forth in this specification and in Division III, "Material Details."
- B. Cement shall conform to ~~the requirements of~~ Section 701, "Hydraulic Cement." ~~of the Uniform Standard Specifications.~~
- C. Sand shall conform to ~~the requirements of~~ Subsection 706.03.03, "Fine Aggregate."
- D. The dry mixture shall consist of ~~one (1)~~ part Portland Cement to ~~four (4)~~ parts sand, thoroughly mixed in a dry state.
  - 1. Measurement may be either by volume or weight.
  - 2. Before placing the proportioned materials in the hopper of the application gun, all lumps ~~three eighths (3/8) inch (1 centimeter) or~~ and over shall be removed by screening.
- E. The premixed mortar shall contain not less than 610 pounds of Portland cement per cubic yard ~~(362 kilograms per cubic meter)~~ fine aggregate and water. A maximum of 30 percent ~~S~~size #89 aggregate as defined in ASTM D448 may be substituted for fine aggregate.
- F. Mesh reinforcing for ditch lining and slope paving reinforcement shall be of the sizes shown on the plans, shall be fabricated of cold drawn steel wire, and need not be galvanized. Mesh reinforcing shall conform to ~~the requirements of~~ ASTM A185.
- G. Header boards consisting of 2-inch by " x 4-inch " ~~(5 x 10 centimeters)~~ redwood lumber furnished and placed in the concrete slope paving shall be as shown on the plans. Lumber used in the construction of header boards shall be commercial grade heart redwood, S4S.
- H. Nails used on construction of header boards shall be commercial quality galvanized nails.

~~03~~CONSTRUCTION**612.03.01 PREPARATION OF SUBGRADE**

- A. The subgrade for paved ditches and slope paving shall be formed by excavation to the required depth below the prepared finish surface grade in accordance with dimensions and design indicated on the plans or as directed by the Engineer.
- B. The subgrade shall be thoroughly compacted.
  - 1. Any soft, spongy, or other unsuitable material shall be removed to ~~such~~the depth ~~as~~ directed by the Engineer, ~~and~~ backfilled with suitable material, and thoroughly compacted.
  - 2. Water shall be sprinkled on the subgrade during compaction, ~~and~~
  - 3. ~~t~~The subgrade shall be sufficiently moist prior to placing concrete mortar to prevent absorption.

**612.03.02 PLACING**

- A. Prior to placing slope paving for use in the work, the Contractor shall construct sufficient test panels to assure the Engineer that the proper color has been obtained, ~~and~~
  - 1. ~~t~~The final panel shall be at least 4 feet' ~~\*by~~ 6 feet' ~~(1.2 x 1.8 meters)~~ in size.
  - 2. The panels shall be constructed at the construction site and shall be placed by a method to be used in placing slope pavement.
- B. The Engineer shall be the sole judge of compliance of the test panel construction with ~~the requirement of~~ these specifications.
- C. Header boards shall be installed to conform to the grades of the slope paving, ~~and~~ to the dimensions, spaces, and layout shown on the plans.
- D. Header boards shall be held in position with stakes of suitable size and length as shown on the plans.
- E. A constant pressure of not less than 45 ~~psi pounds per square inch (310 KPa)~~ shall be maintained in the placing machine where the hose length is 100 feet ~~(30 meters)~~ or less and the pressure shall be increased at least 5 ~~psi pounds (34 KPa)~~ for each additional 50 feet ~~(15 meters)~~ of hose or fraction thereof.
- F. Water used for hydration at the nozzle shall be maintained at a uniform pressure, which shall not be less than 15 ~~psi pounds per square inch (103 KPa)~~ greater than the air pressure at the machine.
- G. The nozzle shall be held at ~~such~~a distance and in ~~such~~a position so that the flowing stream of material will impinge, as nearly as possible, at right angles to the surface being covered.
  - 1. Any deposits of loose sand shall be cut out.
  - 2. All rebound materials shall be wasted.
- H. The Contractor shall do this work only with experienced personnel.
- I. Materials that have been mixed for more than 45 minutes and have not been incorporated in the work shall not be used, unless otherwise permitted by the Engineer.

## PNEUMATICALLY PLACED CONCRETE MORTAR

612

- J. Mortar shall not be placed against frosted or frozen surface. If mortar is placed during the cold weather, it shall be heated and protected during placing and curing as set forth in Section 501, "Portland Cement Concrete," except mortar shall be maintained at a temperature of not less than 50 degrees F. ~~(10-degrees-C.)~~ for 72 hours after placing and at not less than 40 degrees F. ~~(4-degrees-C.)~~ for an additional ~~four~~ 4 days.
- K. The ditch lining and slope paving shall be constructed without expansion joints. Suitable forms shall be used where necessary to insure full dimensions as shown on the plans at the perimeter of the lining.
- L. The mesh reinforcing shall be placed ~~so as to be in~~ the approximate center of the pneumatically placed concrete mortar. All joints shall be lapped ~~six (6) inches (15 centimeters)~~ and run continuously throughout paving or between headers.
- M. After the work is completed, the Contractor shall remove all debris from the work.

**612.03.03 FINISHING**

- A. After the mortar has been placed to the required depth, the surface shall be checked with a straightedge, and any low spots or depressions shall be brought up to grade by placing additional mortar ~~in such a manner~~ so that the finished surface will be smooth and uniform for the type of work involved.
- B. Loose areas of air-blown mortar shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency ~~his expense~~. The surface finish of the exposed slope paving shall be the equivalent of a wood float finish, unless otherwise specified.
- C. Immediately after completion, the surface shall be covered with wet burlap or wet cotton mats and ~~these mats~~ kept wet for at least ~~seventy-two (72)~~ hours. When approved by the Engineer, mortar may be cured by the use of a waterproof or liquid membrane ~~or by means of a liquid membrane, all conforming to the requirements as set forth in Section 702, "Concrete Curing Materials and Admixtures," of the Standard Specifications~~ and these specifications.

~~04~~ METHOD OF MEASUREMENT**612.04.01 MEASUREMENT**

- A. Pneumatically placed concrete mortar will be measured in square yards ~~(square meters)~~ of the actual surface covered to the depth shown on the plans.

~~05~~ BASIS OF PAYMENT**612.05.01 PAYMENT**

- A. The quantity, measured as provided above, will be paid for at the contract unit price bid per square yard ~~(square meter)~~ for "Pneumatically Placed Concrete Mortar (    inch, ~~centimeter,~~ depth)," which ~~payment~~ shall be full compensation for excavation, backfill, furnishing and installing redwood headers, and mortar; for ~~and~~ all labor, tools, equipment, and incidentals; and for doing all the work involved in placing the pneumatically placed mortar, (including subgrade preparation, forming, and curing), complete in place, as shown on the plans and as specified herein, and as directed by the Engineer.
- B. Mesh reinforcement may be measured and paid for as specified in Section 505, "Reinforcing Steel," ~~of the Standard Specifications,~~ unless otherwise specified.

612

PNEUMATICALLY PLACED CONCRETE MORTAR

- C. Note: If the Contractor elects to place the slope paving by other methods approved by the Engineer, the method of measurement and basis of payment will not be changed.
- D. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- E. Payment will be made under:

**PAY ITEM**

**PAY UNIT**

Pneumatically Placed Concrete Mortar (inch depth) ... Square Yard ~~(Meter (inch, centimeter, depth))~~



**SECTION 613****CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS****DESCRIPTION****613.01.01 GENERAL**

- A. Concrete curb, walk, gutters, cross gutters, driveways, and alley intersections shall be constructed of Portland cement concrete prepared as prescribed in Section 501, "Portland Cement Concrete."

**MATERIALS****613.02.01 GENERAL**

- A. Materials shall conform to the applicable requirements of Section 501, "Portland Cement Concrete," Section 502, "Concrete Structures," and Section 505, "Reinforcing Steel."

**CONSTRUCTION****613.03.01 GENERAL**

- A. The thickness of Type I or II aggregate Bbase under Cconcrete Ccurbs, Ggutters, Wwalks, Ddriveways, and Aalley Iintersections shall be as shown on the Pplans or Standard Drawings or as specified in the Special Provisions.
- B. The subgrade shall be constructed true to grade and cross sections as shown on the Plans or as established by the Engineer.
- C. ~~H~~The subgrade shall be watered and compacted until the subgrade reaches the compaction required for the adjacent roadway or base course.

**613.03.02 DIMENSIONS**

- A. The dimensions of the concrete curbs, gutters, walks, driveways, and alley intersections shall be as shown on the Plans or Standards Drawings or as specified in the Special Provisions.

**613.03.03 DRAINAGE OUTLETS THROUGH CURB**

- A. The Contractor ~~will be required to~~shall provide suitable outlets through new curb for all existing building drains along the line of the work. ~~H~~The Contractor shall place outlets opposite any low area on adjacent property, the drainage of which will be ~~e~~affected by the new work.
- B. Where sidewalk or curb will be higher than adjacent property, the Contractor shall provide at least one ~~four (4)-inch (10-centimeters)~~ diameter opening through the curb for each parcel when directed by the Engineer.

**613.03.04 DRIVEWAY ENTRANCES AND ALLEY INTERSECTIONS**

- A. Driveway entrances and alley intersections shall be provided in new curb at all existing driveways and alley intersections along the line of the work at locations shown on the Pplans or Standard Drawings, or as specified in the Special Provisions.

## 613 CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS

**613.03.05 STANDARD FORMS**

- A. Form material shall be free from warp, with smooth and straight upper edges, and, if used for the face of curb, shall be surfaced on the side against which the concrete is to be placed.
- B. Wooden forms for straight work shall have a net thickness of at least ~~one and one-half (1-1/2) inches (3.8 centimeters)~~; metal forms for such work shall be of a gauge that will provide equivalent rigidity and strength.
- C. Curb face forms used on monolithic curb and gutter construction shall be of a single plank width when the curb face is ~~ten (10) inches (25 centimeters)~~ or less, except for those used on curb returns.
  - 1. Wooden forms used on curb returns shall be not less than ~~three-fourths (3/4) inch (1.9 centimeters)~~ in thickness, cut in the length and radius as shown on the plans, and held rigidly in place by the use of metal stakes and clamps.
  - 2. The curb face shall be cut to conform exactly with the curb face batter as well as being cut in the required length and radius.
  - 3. Forms shall be of sufficient rigidity and strength, and shall be ~~so-supported, as~~ to adequately resist springing or deflection from placing and tamping the concrete.
  - 4. Metal forms shall not be used for curb returns or on curves of less than 250-foot radius.
- D. Form material shall be clean at the time it is used, and shall be given a coating of light oil, or other equally suitable material, immediately prior to the placing of the concrete.
- E. All forms, except back planks of curb, shall be set with the upper edges flush with the specified grade of the finished surface of the improvement to be constructed, and all forms shall be not less than a depth equivalent to the full specified thickness of the concrete to be placed.
- F. Back forms shall be held securely in place by ~~means of~~ stakes driven in pairs at an interval not to exceed ~~four (4) feet (1.2 meters)~~, ~~one~~ 1 at the front form and ~~one~~ 1 at the back.
  - 1. Clamps, spreaders, and braces shall be used ~~to such extent as may be necessary~~ to ensure proper form rigidity.
  - 2. Forms for walk, gutter, and similar work shall be firmly secured by ~~means of~~ stakes driven flush with the upper edge of the form at intervals not to exceed ~~five (5) feet (1.5 meters)~~.
  - 3. Form stakes shall be of sufficient size and be driven ~~so as~~ to adequately resist lateral displacement.
- G. Commercial form clamps for the curb and gutter may be used, provided they clamps fulfill the requirements specified herein.

**613.03.06 SLIP FORMS**

- A. At the option of the Contractor and with the approval of the Engineer, slip form equipment may be used for the construction of concrete curb and gutter and concrete curb, gutter, and sidewalk except for commercial driveways and curb returns with valley gutters.
- B. If machines designed specifically for such work and approved by the Engineer are used, the results ~~must~~ shall be equal to or better than that produced by the use of forms.

## CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS 613

1. If the results are not satisfactory to the Engineer, the use of the machines will be discontinued.
  2. All applicable requirements of construction by use of forms shall apply to the use of machines.
- C. Slip form equipment shall be provided with traveling side and top forms of suitable dimensions, shapes, and strength to support the concrete for a sufficient length of time during placement to produce curb and gutter of the required cross section. The equipment shall spread, consolidate, and screed the freshly placed concrete in such a manner as to provide a dense and homogeneous product.
- D. Any curb, except on structures, may be placed by using an extrusion machine provided the finished curb is true to line and grade and the concrete is dense and of the required surface texture and strength. The combined aggregate for the concrete placed by the extrusion method shall be of such size that the percentage composition by weight will conform to the Grading Limits of Combined Aggregates as specified in Subsection 706.02.01, "General." for the ~~three-fourths (3/4)-inch (1.9-centimeters)~~ maximum grading.
- E. The grading limits shall be further restricted, if necessary, to produce concrete that after extrusion has well defined web marks of water on the surface and is free from surface pits larger than ~~three-sixteenths (3/16)-inch (0.5-centimeters)~~ in diameter.
- F. The concrete shall be of such consistency that after extrusion, the concrete will maintain the shape of the curb section without support. ~~It~~ The concrete shall contain the maximum amount of water that will permit this result.
- G. In lieu of placing dowels and bar reinforcing steel and in advance of placing curbs on existing pavement or base, the surface shall be thoroughly cleaned and the adhesive specified below shall be applied.
1. Cleaning of the pavement or base shall be accomplished by wire brushing or by blast cleaning if the latter method is ordered by the Engineer.
  2. The cleaned surface shall be free from dust, loose material, ~~or~~ and oil.
- H. The adhesive shall consist of ~~two (2)~~ components which shall be mixed together at the site of the work and shall conform to ~~the requirements of~~ "Subsection 728.03.11, "Binder (Adhesive), Structural Epoxy."
- I. The grade for the top of the curb shall be indicated by an offset guide line set by the Contractor from survey marks established by the Engineer.
1. The forming tube portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine to provide, when necessary, a variable height of curb conforming to the predetermined curb grade.
  2. A grade line gauge or pointer shall be attached to the machine in such manner that a continual comparison can be made between the curb being placed and established curb grade as indicated by the offset guide line.
- J. In lieu of the above method for maintaining the curb grade, the extrusion machine may be operated on rails or forms set at uniform depth below the predetermined finished top of the grade.
- K. The top and face of the finished curb shall be true and straight, and the top surface of curbs shall be of uniform width, free from humps, sags, or other irregularities. When a

## 613 CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS

straightedge ~~ten (10.) feet (3 meters)~~ long is laid on the top or face of the curb or on the surface of gutters, the surface shall not vary more than 0.01 ~~foot (0.30 centimeters)~~ from the edge of the straightedge, except at grade changes or curves.

L. Extrusion Machines:

1. Crawler track driven extrusion machines shall not be used on finished course plantmix surface.
2. Concrete shall be fed to the machine at a uniform rate.
3. The machine shall be operated under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete free from surface pits larger than ~~three sixteenths (3/16.) inch (0.48 centimeters)~~ in diameter and requiring no further finishing, other than light brushing with a brush filled with water only.
4. Finishing with a brush application of grout will not be permitted.

M. Expansion joints shall be required at E-C<sub>7</sub> and B-C<sub>7</sub> of curb returns, and also along the line of work at regular intervals not to exceed ~~three hundred (300.) feet (91 meters)~~.

N. Unless otherwise specified, transverse weakened plane joints on curb and gutter produced by an extrusion machine shall be constructed at ~~ten (10.) foot (3 meters)~~ intervals along the line of the work.

O. Weakened plane joints shall be constructed as specified in Subsection 613.03.10, "Weakened Plane Joints."

P. Expansion joints shall be constructed as specified in Subsection 613.03.09, "Expansion Joints."

Q. Curing of slip form curb, gutter, and sidewalk shall be done as specified in Subsection 613.03.15, "Curing."

**613.03.07 PLACING CONCRETE**

A. Concrete shall be placed on a subgrade sufficiently dampened to ~~ensure~~ ensure that no moisture will be absorbed from the fresh concrete.

B. Concrete shall be placed in curb, gutter, and curb and gutter forms in horizontal layers not exceeding ~~six (6.) inches (15 centimeters)~~ in thickness, each layer being spaded along the forms and thoroughly tamped. Concrete may be placed in layers of more than ~~six (6.) inches (15 centimeters)~~ in thickness only when authorized by the Engineer and when the spading and tamping is sufficient to consolidate the concrete for its entire length.

C. After the concrete for walk has been placed, a strike-off shall be used to bring the surface to the proper elevation when compacted. ~~#The concrete~~ The concrete shall be spaded along the form faces and tamped to ~~ensure~~ ensure a dense and compact mass, and to force the larger aggregate down while bringing to the surface not less than ~~three eighths (3/8.) inch (1 centimeter)~~ of free mortar for finishing purposes.

D. Concrete shall be placed in cross gutters in horizontal layers of not more than ~~four (4.) inches (10 centimeters)~~ in thickness, each layer being spaded along the form faces and thoroughly tamped into a dense and compact mass. If internal vibrators are used, the full specified thickness may be placed in ~~one~~ 1 operation.

E. After the concrete has been placed and tamped, the upper surface shall be struck off to the specified grade.

## CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS 613

**613.03.08 JOINTS**

- A. Joints in concrete curb, gutter, and walk shall be designated as expansion joints and weakened plane joints.

**613.03.09 EXPANSION JOINTS**

- A. Expansion joints shall be constructed in curbs, walk, and gutter as shown on the plans, Standard Drawings, or as specified herein.
1. ~~Such~~The joints shall be filled with pre-molded joint filler conforming ~~with the requirements prescribed in~~to Section 707, "Joint Material."
  2. No ~~such expansion~~ joints shall be constructed in cross gutters, alley intersections, or driveways except as ~~may be~~ approved by the Engineer.
- B. One ~~half~~-inch ~~(1.3 centimeters)~~ joints shall be constructed in curb and gutter at the end of all returns except where cross gutter transitions extend beyond the curb return, in which case the ~~y~~ joints shall be placed at the ends of the cross gutter transition.
1. No joints shall be constructed in returns.
  2. Where monolithic curb and gutter is constructed adjacent to concrete pavement, no expansion joints will be required except at E-C and B-C of curb returns.
- C. Expansion joint filler ~~one-half (1/2)~~-inch ~~(1.3 centimeters)~~ thick shall be placed in walk at the E-C and B-C of all walk returns, around all utility poles ~~which may~~that project into the concrete along the line of the work, and in walk returns between the walk and the back of curb returns when required by the Engineer.
1. At the E-C and B-C and around utility poles, the joint filler ~~strips~~ shall extend the full depth of the concrete placed.
  2. Joint filler strips between walk and curb shall be the depth of the walk plus ~~one (1)~~ inch ~~(2.5 centimeters)~~ with the top set flush with the specified grade at the top of curb.
- D. All expansion joint filler strips shall be installed vertically, ~~and~~ shall extend to the full depth and width of the work in which they are installed, and shall be constructed perpendicular to straight curb or radially to the line of the curb constructed on a curve.
1. Expansion joint filler materials shall completely fill these joints to within ~~one-fourth (1/4)~~ inch ~~(0.6 centimeters)~~ of any surface of the concrete.
  2. Excess filler material shall be trimmed off to the specified dimension in a neat and workman~~ship~~like manner.
  3. During the placing and tamping of the concrete, the filler strip shall be held rigidly and securely in proper position.

**613.03.10 WEAKENED PLANE JOINTS**

- A. Weakened plane joints shall be straight and constructed in accordance with paragraphs ~~(a)~~D or ~~(b)~~E below, unless otherwise shown on the plans.
- B. In walks, joints shall be transverse to the line of work and at regular intervals not exceeding ~~ten (10)~~ feet ~~(3 meters)~~. At curves and walk returns, the joints shall be radial.

## 613 CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS

- C. In gutters, including gutters integral with curb, joints shall be at regular intervals not exceeding ~~ten (10) feet (3 meters)~~. Where integral curb and gutter is adjacent to concrete pavement, the joints shall be aligned with the pavement joints where practical.
- D. ~~(a)~~ **Control Joint.**
1. After preliminary trowelling, the concrete shall be parted to a depth of ~~two (2) inches (5 centimeters)~~ with a straightedge to create a division in the coarse aggregate.
  2. The concrete shall be refloated to fill the parted joint with mortar.
  3. Headers shall be marked to locate the weakened plane for final joint finishing, which shall be accomplished with a jointer tool having a depth of ~~one-half (1/2) inch (1.3 centimeters)~~ and a radius of ~~one-eighth (1/8) inch (0.3 centimeters)~~.
  4. The finished joint opening shall not be wider than ~~one-eighth (1/8) inch (0.3 centimeters)~~.
- E. ~~(b)~~ **Plastic Control Joint.**
1. The joint material shall be a T-shaped plastic strip at least ~~one (1) inch (2.5 centimeters)~~ deep, having suitable anchorage to prevent vertical movement, and having a removable stiffener with a width of at least ~~three-fourths (3/4) inch (1.9 centimeters)~~.
  2. After preliminary trowelling, the concrete shall be parted to a depth of ~~two (2) inches (5 centimeters)~~ with a straightedge.
  3. The plastic strip shall be inserted in the impression so that the upper surface of the removable stiffener is flush with the concrete.
  4. After floating the concrete to fill all adjacent voids, the removable stiffener shall be stripped.
  5. During final trowelling, the edges shall be finished to a radius of ~~one-eighth (1/8) inch (0.3 centimeters)~~ using a slit jointer tool.

## 613.03.11 FINISHING

- A. Finishing shall be completed as specified herein for the type of work being performed.

## 613.03.12 CURB

- A. The front forms may be stripped as soon as the concrete has set sufficiently.
- B. The face and top of the curb shall be carefully trowelled to a smooth and even finish; the top ~~being shall be~~ finished to a transverse slope of ~~one-fourth (1/4) inch (0.6 centimeters)~~ toward the gutter, with both edges rounded to a radius of ~~three-fourths (3/4) inch (1.9 centimeters)~~.
- C. The trowelled surface shall be finished with a fine hair broom applied parallel with the line of the work.
- D. The edge of the concrete at all expansion joints shall be rounded to a ~~one-fourth (1/4) inch (0.6 centimeters)~~ radius.
- E. The surface of the work shall be finished as prescribed; after which the name of the Contractor, together with the year in which the improvement is constructed, shall be stamped therein to a depth of ~~one-fourth (1/4) inch (0.6 centimeters)~~, in letters not less than ~~three-fourths (3/4) inch (1.9 centimeters)~~ high, at B-C and E-C curb returns.



**613.03.13 WALK**

- A. The forms shall be set to place the finished surface in a plane sloping up from the top of curb at a rate of ~~one-fourth (1/4)~~ inch to ~~one (1)~~ foot ~~(0.6 to 30 centimeters)~~ when measured at right angles to the curb.
- B. Following placing, the concrete shall be screeded to the required grade, tamped to consolidate the concrete and to bring a thin layer of mortar to the surface, and floated to a smooth, flat, uniform surface. The concrete shall then be edged at all headers, given a preliminary trowelling, and provided with weakened plane joints.
- C. Walks shall be steel trowelled to a smooth and even finish.
  - 1. All formed edges shall be rounded to a radius of ~~one-half (1/2)~~ inch ~~(1.3 centimeters)~~.
  - 2. Edges at expansion joints shall be rounded to a radius of ~~one-eighth (1/8)~~ inch ~~(0.3 centimeters)~~.
  - 3. Preliminary trowelling may be done with a long-handled trowel or "Fresno", but the finish trowelling shall be done with a hand trowel.
  - 4. After final trowelling, walks on grades of less than 6 percent shall be given a fine hair broom finish applied transverse to the centerline.
  - 5. On grades exceeding 6 percent, walks shall be finished by hand with a wood float.
  - 6. Walks shall be remarked as necessary after final finish, to assure neat uniform edges, joints, and weakened plane lines.
- D. Weakened plane lines, where required, shall have a minimum depth of ~~one and one-half (1-1/2)~~ inch ~~(3.8 centimeters)~~ and a radius of ~~one-eighth (1/8)~~ inch ~~(0.3 centimeters)~~.
  - 1. When longitudinal weakened plane lines are required, they shall be parallel to, or concentric with, the lines of the work.
  - 2. Walks ~~twenty (20)~~ feet ~~(6.1 meters)~~ or more in width shall have a longitudinal center weakened plane line.
  - 3. In walk returns, ~~one~~ weakened plane line shall be made radially midway between the B-C-R and E-C-R.
  - 4. When directed by the Engineer, longitudinal and transverse weakened plane lines shall match the adjacent walk.
  - 5. The Contractor shall have sufficient metal bars, straightedges, and joint tools on the project.
- E. Headers shall remain in place for at least ~~sixteen (16)~~ hours after completion of the walk but ~~must~~ shall be removed before the work is accepted.
- F. The name of the Contractor, together with the year in which the improvement is constructed, shall be stamped therein to a depth of 1/4 ~~-of an~~ inch, in letters not less than 3/4 ~~-of an~~ inch, at intervals of not less than 200 feet.
  - 1. A metal identification plate with the exposed face set flush with the finished surface of the concrete, anchored to a depth of not less than 1-1/2 inches, may be substituted for the stamping in the concrete.
  - 2. At least ~~one~~ such stamping or identification plate shall be made on each cement concrete job at the project.

613 CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS

**613.03.14 GUTTER**

- A. After the concrete has been thoroughly tamped in such manner as to force the larger aggregate into the concrete and bring to the top sufficient free mortar for finishing, the surface shall be worked to a true and even grade by means of a float, trowelled with a long-handled trowel (or "Fresno") and wood float finished.
  - 1. The flow line of the gutter shall be trowelled smooth for a width of approximately ~~four (4) inches (10 centimeters)~~ for integral curb and gutter and ~~four (4) inches (10 centimeters)~~ on either side of the flow line on cross and longitudinal gutters.
  - 2. The outer edges of the gutter shall be rounded to a radius of ~~one-half (1/2) inch (1.3 centimeters)~~.
- B. Side forms shall remain in place for at least ~~twenty-four (24) hours~~ after completion of the gutter, but ~~must~~shall be removed before the work will be accepted.
- C. Median island paving shall be as shown on the Standard Drawings.

**613.03.15 CURING**

- A. Immediately after finishing operations are completed, the exposed surfaces shall be cured in accordance with Section 502, "Concrete Structures."

**613.03.16 REPAIRS AND REPLACEMENTS**

- A. Any new work found to be defective or damaged prior to its acceptance shall be repaired or replaced by the Contractor at no ~~expense~~additional cost to the Contracting Agency and in accordance with Subsection 105.12, "Removal of Unacceptable and Unauthorized Work."

**613.03.17 BACKFILLING AND CLEANUP**

- A. Backfilling to the finished surface of the newly constructed improvement ~~must~~shall be complete before acceptance of the work.
- B. Upon completion of the work, the surface of the concrete shall be thoroughly cleaned and the site left in a neat and orderly condition.

**613.03.18 DETECTABLE WARNINGS**

- A. In accordance with the Americans with Disabilities Act (ADA), detectable warnings shall be constructed on all sidewalk ramps.
- B. Detectable warnings shall provide a tactile surface which visually contrasts with ramp and street surfaces to assist visually impaired persons in the identification of street and driveway crossings.
- C. Detectable warnings shall be constructed at the bottom of sidewalk ramps to a minimum depth of 24 inches ~~(640 millimeters)~~ and extending the full width of the ramp in accordance with ~~Uniform~~the Standard Drawings.
- D. The materials and method of constructing the warning strips shall be as directed by the Engineer of the entity having jurisdiction over the ramp.
- E. Additional information on detectable warning materials and applications is available from the U.S. Access Board.



## CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS

613

## MEASUREMENT

**613.04.01 METHOD OF MEASUREMENT**

- A. The quantity of curb, gutter, and combination curb and gutter measured for payment will be the number of linear feet ~~(meters)~~ along the base of the curb face or along the flow line of the gutter.
- B. The quantity of sidewalk, driveway, and alley intersections shall be measured for payment by area in square feet ~~(square meters)~~.
- C. In the case of integral curb and walk, the width of the walk shall extend to the back face of the curb.
- D. All quantities measured for payment herein will be complete and in place.
- E. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**613.05.01 PAYMENT**

- A. The accepted quantities of concrete measured as provided in Subsection 613.04.01, "Measurement," will be paid for at the contract unit price bid per linear feet ~~(meter)~~ for curb, gutter, curb and gutter and per square foot ~~(square meter)~~ for sidewalks, driveways, valley gutters, or and alley intersections ~~as the case may be~~.
- B. All excavation and base course work required for and performed during construction of the items of this section will be paid for as provided in the respective sections of the specifications; however, when the contract does not provide bid items for excavation or base course, such work required and performed will be considered subsidiary to the pay item contained herein and no further payment will be made therefor.
- C. Any excavation or backfill required other than roadway quantities will be considered subsidiary to the major items of work and no further payment will be made therefor.
- D. Reinforcing steel placed in curbs and gutters as shown on the plans or ordered by the Engineer will not be paid for directly but the cost thereof shall be considered as included in the contract bid prices for other items of work.
- E. All payments shall be made in accordance with Subsection 109.02, "Scope of Payment."
- F. Payment will be made under:

**PAY ITEM****PAY UNIT**

Type A Curb.....	Linear Foot <del>(Meter)</del>
Type L Island Curb and Gutter .....	Linear Foot <del>(Meter)</del>
Type L Curb and Gutter .....	Linear Foot <del>(Meter)</del>
Concrete Sidewalk.....	Square Foot <del>(Square Meter)</del>
Concrete Driveway .....	Square Foot <del>(Square Meter)</del>
Concrete Sidewalk and Driveway.....	Square Foot <del>(Square Meter)</del>
Concrete Alley Intersection.....	Square Foot <del>(Square Meter)</del>
Concrete Valley Gutter .....	Square Foot <del>(Square Meter)</del>
Concrete Commercial Driveway .....	Square Foot <del>(Square Meter)</del>

**SECTION 614****PAINTING****DESCRIPTION****614.01.01 GENERAL**

- A. This work shall consist of the preparation of surfaces to be painted and the application, protection, and drying of the required number of coats of paint of the kinds and at the points specified or ordered by the Engineer.

**MATERIALS****614.02.01 GENERAL**

- A. Materials shall meet or exceed the minimum standards hereinafter set forth.
- B. ~~(a)~~ **Materials:**
1. The raw materials for use in the various paint formulas shall conform to the specifications designated by Federal or Military serial number or paint material code number under the various paint classifications hereinafter specified.
  2. Subsequent amendments to the specifications quoted shall apply to all raw materials and finished products.
  3. No "or equal" substitutions for any specified material shall be made without written consent of the Engineer.
- C. ~~(b)~~ **Manufacturing and Packaging:**
1. All manufactured paint shall be prepared at the factory ready for application.
  2. The addition of thinner or other material to the paint after the paint has been shipped will not be permitted, unless so specified.
  3. The finished paint shall be furnished in new, round steel containers of not more than 6-gallon capacity and of metal not thinner than 0.024-inch nominal thickness.
    - a. The containers shall have lug type crimp lids with ring seals and be equipped with ears and bails.
    - b. The containers shall meet U.S. Department of Transportation Hazardous Material Shipping Regulations.
    - c. The container shall be lined if necessary to prevent attack by the paint.
    - d. The lining shall not come off the can as skins.
  4. No finished paint shall be used until at least 7 days have elapsed from the date of its manufacture.
  5. All containers of paint shall be labeled showing the exact title of the paint specification, California State specifications number, manufacturer's name, date of manufacture, and manufacturer's batch number.
  6. Precautions concerning the handling and the application of paint shall be shown on the label of paint and solvent containers.

**614.02.02 NUMBER OF COATS**

- A. Unless otherwise required in the contract documents, the number and kinds of coats of paint shall be as set forth in Section 714, "Paint and Pavement Markings."

**CONSTRUCTION****614.03.01 WEATHER CONDITIONS**

- A. Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather.
1. Except as provided below, painting will not be permitted when weather conditions during applications are such that the atmospheric temperature is at or below ~~forty (40) degrees Fahrenheit (4 degrees Celsius)~~ or when freshly painted surfaces may become damaged by rain, wind, dust, or condensation, or when it can be anticipated that the atmospheric temperature will drop below ~~forty (40) degrees Fahrenheit (4 degrees Celsius)~~, during the drying period.
  2. If fresh paint is damaged by the elements, the paint shall be replaced by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.
- B. Subject to the approval of the Engineer in writing, the Contractor may provide suitable enclosures to permit painting during inclement weather.
1. Provisions ~~must~~ shall be made to control atmospheric conditions artificially inside the enclosures within the limits suitable for painting throughout the painting operation.
  2. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

**614.03.02 APPLICATION ~~--~~ GENERAL**

- A. Painting shall be done in a neat and workmanlike manner.
- B. Unless otherwise specified, paint shall be applied ~~either~~ by brush, roller, or spray methods.
1. ~~If brushes are used, they~~ shall have sufficient body and length of bristle to spread the paint in a uniform coat.
  2. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes.
  3. Paint shall be evenly spread and thoroughly brushed out.
  4. If a considerable amount of brush marks appear, it will be considered that the paint has been improperly applied.
  5. ~~If rollers are used, they~~ shall be of a type that do not leave a stippled texture in the paint film.
- C. Work ~~which~~ that is defective shall be refinished or repainted as directed ~~without~~ at no additional cost to the Contracting Agency.
- D. On surfaces ~~which~~ that are inaccessible for brushing, the paint shall be applied by sheepskin daubers or by other means approved by the Engineer.

## PAINTING

614

- E. If spray methods are used, the operator shall be experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence that the work is unsatisfactory and the Contractor may be required to apply the remainder of the paint by brush.
- F. Mechanical mixers shall be used to mix the paint.
  - 1. The paint shall be mixed to thoroughly blend the pigment and vehicle together.
  - 2. Paint shall be kept mixed while being applied.
- G. Paint specified or formulated shall be ready for application and thinning will be allowed only on direction of the Engineer.
- H. The Contractor shall protect all parts of the structure being painted against disfigurement by spots of paint or paint materials.
  - 1. When paint is being applied on structures carrying public traffic, the Contractor shall be responsible for damage caused by ~~his~~Contractor's operations to passing ~~the~~ vehicles or persons ~~and~~.
  - 2. The Contractor shall use shields or other protective means to guard against such damage.
- I. Paint stains ~~which~~that result in unsightly appearance shall immediately be removed by the Contractor at ~~his expense~~no additional cost to the Contracting Agency.

**614.03.03 SURFACE PREPARATION OF STEEL**

- A. The following methods of surface preparation apply to steel surfaces. Unless otherwise specified, the sand blasting method shall be used.
- B. ~~(a)~~ **Sand Blasting**:
  - 1. Dirt, mill scale, rust, stain, old paint, and other foreign material shall be removed from steel surfaces by an approved blast cleaning apparatus.
  - 2. Blast cleaning shall be sufficient to give the surface the appearance of unpolished cast aluminum.
  - 3. Abrasives used for ~~such~~ blast cleaning shall be ~~either~~ clean dry sand, mineral grit, steel shot, or steel grit, at the option of the Contractor, and shall be of a grading suitable to produce satisfactory results.
  - 4. The use of abrasives other than those specified herein will not be permitted unless approved in writing by the Engineer.
  - 5. When sand blasting is being performed on structures open to traffic, the Contractor shall provide suitable protective devices to prevent damage to traffic.
  - 6. When sand blasting is being performed near machinery, all journals, bearings, motors, and moving parts shall be sealed against entry of sand dust before sand blasting begins.
  - 7. Unless otherwise authorized by the Engineer, sand blasted surfaces shall be primed or treated the same day sand blasting is done.
  - 8. If cleaned surfaces rust before painting is accomplished, ~~they~~ surfaces shall be recleaned by the Contractor.

C. ~~(b)~~ **Washes:-**

1. Rust-inhibitor chemical washes shall be applied to freshly sand blasted steel surfaces prior to the application of the first undercoat of paint, except when the first undercoat of paint is applied to the cleaned surfaces within a ~~four (4)~~ hour period after cleaning, washes will not be required.
2. Washes shall be applied in not more than ~~four (4)~~ hour intervals.
3. If in the opinion of the Engineer, atmospheric conditions are such that corrosion ~~products~~ forms on freshly sand blasted surfaces in less than ~~four (4)~~ hours, treatment may be required at more frequent intervals.
4. Rust-inhibitor chemical washes may be applied by brush or spray, and they washes shall be applied in a careful manner to iensure that all surfaces are covered.
5. During the application of the rust-inhibitor chemical wash in no sand blasting will be permitted in the areas being treated.
6. No paint shall be applied until the treated surfaces have dried.
7. The first undercoat of paint shall be applied to the treated surfaces the same day that cleaning and washing have been done.

D. ~~(c)~~ **Steam Cleaning:-**

1. Dirt, grease, loose chalky paint, ~~or~~ and other foreign material ~~which~~ that has accumulated on the previously painted surfaces shall be removed with an approved steam cleaning apparatus which shall precede all other phases of cleaning.
2. It is not intended that sound paint be removed by this process.
3. Subsequent painting shall not be performed until the cleaned surfaces are thoroughly dry and in no case in less than ~~twenty-four (24)~~ hours after cleaning.
4. A detergent soap consisting of ~~forty-five~~ 45 percent sodium metasilicate, ~~forty-three (43)~~ percent sodium sesquisilicate, ~~ten (10)~~ percent sodium tetraphosphate, i and ~~two (2)~~ percent Naccanol shall be added to the feed water of the steam generator at the approximate rate of ~~one (1)~~ pound ~~(0.45 kilograms)~~ of detergent per ~~two hundred (200)~~ pounds ~~(90 kilograms)~~ of water.
5. Any residue ~~which~~ that may accumulate on cleaned surfaces shall be removed by flushing with fresh water in but washing down the cleaned surfaces will not otherwise be required.

E. ~~(d)~~ **Hand Cleaning:-**

1. Dirt, loose rusts, ~~and~~ mill scale, dead paint, or paint ~~which~~ that is not firmly bonded to the metal surfaces shall be removed by ~~wire brushes, either hand or powered~~ wire brushes, hand scraping tools in or sandpaper.
2. Pneumatic chipping hammers will not be allowed unless authorized in writing by the Engineer.
3. Hand cleaning shall be sufficient to remove all loose material ~~which~~ that would prevent the bond of succeeding coats of paint.

- F. If the amount of steel to be painted exceeds 100 tons in ~~(100 metric tons)~~ the surface shall be prepared by method B(a), "Sand Blasting"; however, if the amount to be painted is 100 tons ~~(100 metric tons)~~ or less in the surface may be prepared by method E(d), "Hand Cleaning."

## PAINTING

614

**614.03.04 PAINTING STRUCTURAL STEEL:****A. ~~(a)~~ Paint:**

1. Unless otherwise required in the contract documents, the paints to be applied to steel surfaces shall conform to ~~the requirements of~~ Section 714, "Paint and Pavement Markings."
2. The undercoats shall consist of a minimum dry film thickness of ~~one (1) mil (.025 millimeters)~~ per coat.
3. The finish coat shall consist of a minimum dry film thickness of ~~one (1) mil (.025 millimeters)~~.
4. The total thickness of all coats shall be not less than ~~three (3) mils (.076 millimeters)~~.
5. Excessively thick coats of paint will not be permitted.
6. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

**B. ~~(b)~~ Field Cleaning:**

1. Unless otherwise specified in the contract documents, after erection and riveting or welding, all surfaces of unpainted structural steel, ~~which that~~ will be exposed to air, shall be sand blasted in accordance with ~~the requirements of~~ Subsection 614.03.03, "Surface Preparation of Steel."
2. Any damage to sound paint, on areas not designated for treatment, resulting from the Contractor's operations, shall be repaired to the satisfaction of the Engineer.

**C. ~~(c)~~ Painting:**

1. Painting of structural steel prior to erection will be limited to surface preparation and one undercoat of paint.
2. Any deficiencies in the first coat of paint shall be corrected to the satisfaction of the Engineer, prior to the application of succeeding coats of paint.
3. Surfaces exposed to the atmosphere ~~which that~~ would be inaccessible for painting after erection shall be painted the full number of coats prior to erection.
4. The surface of the paint coat being covered shall be free from moisture, dust, grease, or any other deleterious material ~~which that~~ would prevent the bond of the succeeding paint coats.
5. In spot painting, any old paint ~~which that~~ lifts after application of the first spot coat, shall be removed by scraping and the area repainted before application of the next coat.
6. The application of the finish coat will be permitted until the required total film thickness of the undercoats of paint, as described in A(a), above, is obtained.
7. Open seams at contact surfaces of built-up members ~~which that~~ would retain moisture shall be caulked with red lead paste before applying the second undercoat of paint.
8. Metal surfaces embedded in concrete need not be painted.

**D. ~~(d)~~ Machine Finished Surfaces:-**

1. With the exception of abutting chord and column splices and column and truss shoe bases, machine finished surfaces shall be coated with a rust inhibitor ~~which~~that can be easily removed.
2. Surfaces of iron and steel castings ~~which~~that have been machine finished shall be painted with a coat of shop paint.

**E. ~~(e)~~ Frames and Grates:-**

1. Prior to installation, all surfaces of frames and grates exposed to the atmosphere shall be painted with ~~two~~2 coats of paint.
2. Unless otherwise specified in the contract documents, the exposed surfaces shall be painted after installation with ~~one~~1 finish coat as specified for structural steel.

**614.03.05 PAINTING TIMBER:-****A. ~~(a)~~ Paint:-**

1. New timber requiring painting shall be painted with ~~three~~3 coats of paint.
2. The paint used for various coats will be as specified in these specifications or in the contract documents.

**B. ~~(b)~~ Preparation of Surfaces:-**

1. Cracked or peeled paint, loose chalky paint, dirt, and other foreign matter shall be removed by wire brushing, scraping, or other approved means immediately prior to painting.
2. Unpainted timber shall be thoroughly dry before paint is applied.

**C. ~~(c)~~ Painting:-**

1. When permitted in writing by the Engineer, the first coat of paint may be applied prior to erection.
2. After the first coat has dried and the timber is in place, cracks, checks, nail holes, ~~etc. and so forth~~, shall be puttied flush with the surface and allowed to dry before the second coat is applied.
3. Skips, holidays, thin areas, or other deficiencies in any coat of paint shall be corrected to the satisfaction of the Engineer before the succeeding coat is applied.
4. The surface of the paint coat being covered shall be free of any deleterious material before any additional paint is applied.

**METHOD OF MEASUREMENT****614.04.01 MEASUREMENT**

- A. ~~BLANK:~~The quantities of painting, cleaning structural steel, and preparing surfaces for painting will not be measured for payment as such.

PAINTING

614

BASIS OF PAYMENT

**614.05.01 PAYMENT**

- A. No direct payment will be made for painting, cleaning structural steel, ~~or~~and preparing surfaces for painting.
- B. Compensation for this work shall be considered as included in the contract unit prices bid for the particular item requiring painting.



**SECTION 615****PRESERVATIVE TREATMENTS FOR TIMBER****DESCRIPTION****615.01.01 GENERAL**

- A. This work shall consist of preservative treatment for lumber, timber, and piles as herein specified.

**MATERIALS****615.02.01 GENERAL**

- A. The materials used shall be those prescribed for the several items ~~which~~that constitute the finished work and shall comply with all the requirements for such materials as set forth in these specifications.
- B. ~~Attention is directed to~~Comply with Section 719, "Timber Preservatives."

**CONSTRUCTION****615.03.01 TREATMENT**

- A. All structural timber, piling, and other lumber shall be thoroughly seasoned or conditioned before treatment.
- B. The method of seasoning, conditioning, and treating used shall conform to the Federal Specification TT-W-571.

**615.03.02 AMOUNT OF PRESERVATIVE**

- A. The minimum amount of preservative retained per cubic foot of timber, lumber, or piling shall conform to the minimum ~~specification~~ requirements of ~~the~~ Federal Specification TT-W-571.
- B. Unless otherwise specified, material treated with pentachlorophenol shall have a minimum retention of ~~eight (8) pounds (3.6 kilograms)~~ unless it is to be painted, then ~~six (6) pounds (2.72 kilograms)~~ will be the minimum retention.
- C. Material to be treated with ~~A~~ammoniacal ~~C~~copper ~~A~~arsenite shall have a net retention of dry salts of not less than 0.3 pounds ~~(0.14 kilograms)~~.

**615.03.03 PRESERVATIVE TREATMENT BY THE HOT-COLD SOAKING METHOD**

- A. When called for on the plans, all lumber and timber to be treated by the hot-cold soaking method shall be well seasoned and free from outer and inner bark, dirt, grease, or other objectionable matter ~~which~~that will in any way hinder the free penetration of the preservative.
- B. All lumber and timber of ~~two (2) inches (5 centimeters)~~ dimensional stock or larger shall be incised.
- C. The preservative used shall be a ~~five (5)~~ percent concentration of pentachlorophenol.

615

## PRESERVATIVE TREATMENTS FOR TIMBER

- D. The tanks used shall be of sufficient size to permit complete submergence of the largest timber of any operation and to allow free circulation of the liquid around the timber being treated.
1. Sufficient liquid shall be maintained in the tank to completely submerge the timber to a minimum depth of ~~six (6) inches-centimeters~~.
  2. When a number of pieces are being treated at ~~one~~ 1 time, each piece shall be separated from the others on all sides by spacers not less than ~~one-fourth (1/4) inch (0.6 centimeters)~~ in least dimension.
  3. Suitable weights or cross bracing shall be provided to keep the material submerged.
- E. The timber or lumber shall be submerged in the cold solution as previously described.
1. The temperature shall be slowly increased for a period of not less than ~~five (5) hours~~ to a minimum temperature of ~~one hundred eighty (180) degrees Fahrenheit (82 degrees Celsius)~~ and not exceeding ~~two hundred ten (210) degrees Fahrenheit (99 degrees Celsius)~~.
  2. After ~~five (5) hours~~ and attaining the minimum specified temperature, the timber or lumber shall be permitted to cool in the solution until such time as the minimum specified quantity of preservative is absorbed by the wood.
- F. Timber for minor irrigation structures, unless otherwise shown on the plans, shall be the No. 1 Common Grade of the species permitted, and shall be treated in accordance with the Hot-Cold Soak Process.
- G. The species permitted and the minimum retention in pounds per cubic foot ~~(kilograms per cubic meter)~~ required are as follows:

Species	Minimum Retention Per Cubic Foot (Pounds) <del>Per Cubic Meter (Kilograms)</del>
Douglas Fir (Rocky Mt., Inland, Coast)	2.0 <del>32</del>
Pine, Yellow (Pinus Ponderosa)	4.0 <del>64.4</del>
Pine, Lodge Pole (Pinus Contorta)	4.0 <del>64.4</del>
Cottonwood, Northern Black (Populus Trichocarpa Hastata)	4.0 <del>64.4</del>

## 615.03.04 INSPECTION

- A. All timber and piling, untreated or to be treated, shall be inspected before treatment by an inspector designated by the Engineer. The inspector shall stamp each piece of timber accepted with a stamp making a legible mark designating the inspector.
- B. All timber and piling shall be inspected after treatment by an inspector designated by the Engineer. The inspector shall stamp each piece accepted with a stamp making a legible mark designating the inspector.
- C. All materials and processes used in the manufacture of material shall be subject to inspection, acceptance, or rejection at the manufacturer's plant, which shall be equipped with all the necessary gauges, appliances, and facilities to enable the inspector to ~~satisfy himself~~ verify that the requirements of the specifications have been fulfilled.

PRESERVATIVE TREATMENTS FOR TIMBER

615

- D. The treated timber and piling shall be free from heat checks, water bursts, excessive checking, results of chafing, ~~or from~~ and other damage ~~or~~ f defects ~~which~~ that would impair its usefulness ~~or~~ and durability.

METHOD OF MEASUREMENT

**615.04.01 MEASUREMENT**

- A. ~~Blank~~ No measurement will be made for treatment of lumber, timber, and piles as such.

BASIS OF PAYMENT

**615.05.01 PAYMENT**

- A. Full compensation for treatment of lumber, timber, and piles as ~~herein~~-specified shall be considered as included in the price paid for particular item of work in which the treated lumber, timber, or piling is used and no additional allowance will be made therefor~~e~~.

**SECTION 616****FENCING****DESCRIPTION****616.01.01 GENERAL**

- A. This work shall consist of furnishing and erecting new standard fence, chain-link fence, gates, or reconstructing fences previously removed, in conformity with these specifications and the plans.
- B. New standard fence shall consist of galvanized barbed wire, galvanized farm fence, or both, fastened to wood posts or metal posts or to a combination of the two kinds of posts as shown on the standard plans.
- C. Chain-link fence shall consist of galvanized or aluminum-coated chain-link fabric attached to metal posts and fastened to a top tensioning cable and a bottom tensioning wire. The height of chain-link fences shall be as designated in the contract documents.

**MATERIALS****616.02.01 GENERAL**

- A. Materials shall conform to the requirements specified in Section 724, "Fence Materials," and [Section 501](#), "Portland Cement Concrete."

**CONSTRUCTION****616.03.01 GENERAL**

- A. All trees, brush, and other obstructions which interfere with proper construction of fences shall be removed and disposed of in accordance with ~~the requirements of~~ Section 201, "Clearing and Grubbing," of these specifications, except that no payment will be made for such work.
- B. When constructing chain-link fence, rocks and other surface irregularities that require moving in order to maintain a nearly smooth surface, shall be removed and no direct payment will be made therefore.
- C. Fence construction operations shall be ~~so~~ conducted ~~as~~ to prevent the escape of livestock.
  - 1. Existing cross fences shall be connected to the new fence.
  - 2. Corner posts, with braces for each direction of strain, shall be placed at the junction with existing fences and the wire in both fences properly fastened to the posts.
  - 3. At bridges and cattle passes, and at culverts if shown on the plans or ordered by the Engineer, the new fence shall be connected to the structure in ~~such a manner as~~ ~~to~~ [that](#) [permits](#) the free passage of livestock through or under the structure.
- D. Barbed wire, farm fence, and chain-link fence fabric shall be fastened on the side of the posts opposite the highway centerline unless otherwise directed by the Engineer.
- E. Post holes for metal posts that are drilled or dug shall be backfilled with concrete.
- F. Galvanized pipe brace rail shall not be spliced.

- G. The first line of barbed wire above wire mesh shall be tied to the top wire of the wire mesh, midway between posts, with 12-gauge galvanized steel wire or 9-gauge aluminum hog rings.
- H. Intermediate Braced Post Assemblies - Timber:
  - 1. The horizontal brace shall be placed ~~six (6) inches (15-centimeters)~~ below the tops of the brace posts and properly fitted and connected to the ~~m posts~~ by two 3/8-inch by 4-inch ~~(0.95 x 10-centimeters)~~ steel dowels.
  - 2. The dowel pins shall extend ~~two (2) inches (5-centimeters)~~ into each brace and brace post.
  - 3. Two strands of 8-gauge galvanized wire shall be run as a brace diagonally from ~~four (4) inches (10-centimeters)~~ above ground line on each brace post to ~~four (4) inches (10-centimeters)~~ below the top of the other brace post.
  - 4. An extra loop shall be made around each post at the point of attachment and the wire firmly stapled to the post.
  - 5. These brace wires shall then be twisted until the assembly is rigid.
- I. Corner post assemblies shall be constructed as indicated on the standard fence details and the end post assemblies shall be composed of end posts and brace posts installed and braced as indicated for timber corner braces.
- J. At the option of the Contractor, timber line posts may be installed by tamping firmly in place in drilled or dug holes or by driving, provided the method of driving does not damage the posts or cause the posts to be deflected from line and plumb.
  - 1. All other timber posts shall be installed in drilled or dug holes and tamped firmly in place.
  - 2. Round timber posts installed in drilled or dug holes shall have the butt end placed downward.
  - 3. Timber line posts ~~which~~that are to be driven, shall be machine pointed at the plant before being treated.
  - 4. The small end of driven round timber posts shall be pointed.
- K. Each strand of barbed wire shall be securely fastened to a corner post, end post, or intermediate braced post assembly by wrapping twice around the post and securing to that part of the same wire stretched between the posts. The remaining wire shall be cut off and the tie shall present a neat and workmanlike appearance.
- L. Staples shall be set ~~so as~~ to hold the wire securely, but ~~should~~shall not be buried in the post in ~~such~~ a manner ~~as to~~that severely nicks or bends the wire.

### 616.03.02 STANDARD FENCE

- A. Standard fencing shall be designated by types as follows:
  - 1. Metal posts - Type A.
  - 2. Wood posts - Type B.
  - 3. Combination metal and wood posts - Type C.
- B. The type of fence construction shall be as shown on the plans and indicated in the proposal.

## FENCING

616

1. Posts shall be firmly set or driven into the ground and spaced as indicated on the plans.
  2. Each end, corner, and gate post shall be firmly braced and shall be set in concrete when required.
  3. Posts shall be braced as indicated in the plans.
- C. Standard fencing will be designated not only by type, but also by a symbol indicating the fencing required.
1. ~~Thus (Type A-832-3B) will be used to~~ designate a fence composed of metal posts, ~~thirty-two (32-) inch (81 centimeters)~~ woven wire (farm fencing), and ~~three~~ 3 barbed wires.
  2. ~~(Type C-726-4B) will to~~ designate a fence composed of a combination of metal and wood posts, ~~twenty-six (26-) inch (66 centimeters)~~ woven wire, and ~~four~~ 4 barbed wires, ~~etc and so forth.~~
  3. The figures 832, ~~etc.~~ and others, when they appear in the symbol, correspond to design numbers set forth in the ~~s~~ Standard plan Drawings.
- D. In general, in determining the post spacing, measurements ~~will~~ shall be made parallel to the slope of the natural ground, ~~and~~
1. ~~a~~ All posts shall be placed in vertical position except in unusual locations where, in the opinion of the Engineer, it would be more satisfactory to place the posts perpendicular to the slope of the ground.
  2. All intervals shall be measured center to center of adjacent posts.
- E. Changes in line where the angle of deflection is ~~thirty (30)~~ degrees or more shall be considered as corners and corner posts shall be installed. Changes in line where the angle deflection is more than ~~fifteen (15)~~ degrees and less than ~~thirty (30)~~ degrees shall be considered as alignment angles, and adjacent posts shall be made fast to the angle posts ~~by means of~~ with wire, or, if such method is impracticable in the opinion of the Engineer, such posts shall be braced as ~~above~~ specified above for bracing gate, end, and corner posts.
- F. At all grade deflections and alignment angles where stresses tend to pull the posts from the ground, the fencing shall be snubbed or guyed at the critical point ~~by means of~~ with a double strand of ~~nine (9)~~ gauge galvanized wire connected to each horizontal line of barbed wire or to the top and bottom of wire mesh fabric, and to a deadman weighing approximately ~~one hundred (100)~~ pounds, buried in the ground not less than ~~(2)~~ feet ~~(0.6 meters)~~. The fencing shall be pulled snug close to the ground before being snubbed or guyed.
- G. Barbed wire and farm fence fabric (woven wire) shall be stretched taut and securely fastened to each post by means of suitable devices approved by the Engineer.

**616.03.03 CHAIN-LINK FENCE**

- A. All posts shall be of a total length of not less than the depth of the concrete footing as shown on the plans, plus the length required above ground.
- B. Changes in line where the angle of deflection is ~~thirty (30)~~ degrees or more shall be considered as corners and corner posts shall be installed.
- C. Between posts, chain-link fences shall be fastened to a bottom tension wire and a top tension cable.

1. The bottom tension wire shall be at least ~~seven-(7)-~~gauge galvanized coil spring wire of good commercial wire.
  2. The top tension cable shall be at least ~~three-eighths-(3/8)-~~inch ~~(0.95-centimeters)~~ diameter galvanized ~~seven-7-~~strand cable conforming to ~~the requirements of the current ASTM Designation A-475~~ common grade.
- D. Line posts shall be spaced at not more than ~~ten-(10)-~~foot ~~(3-meters)~~ intervals, measured from center to center of posts.
1. In general, in determining the post spacing, measurements will be made parallel to the slope of the natural ground. ~~and~~
  2. ~~a~~All posts shall be placed in a vertical position except in unusual locations where, in the opinion of the Engineer, it would be more satisfactory to place the posts perpendicular to the slope of the ground.
- E. All metal posts shall be set in a Portland cement concrete footing crowned at the top to shed water. Depths of footings shall be as shown on the plans.
- F. End, corner, and gate posts shall be braced with galvanized braces used as compression members and galvanized steel truss rods with truss tighteners used as tension members. Line posts, at intervals of ~~five hundred-(500)~~ feet ~~(152-meters)~~, shall be braced and trussed in both directions as shown on the plans.
- G. The fabric shall be stretched taut and securely fastened to the posts. ~~and b~~Between posts, the top edge of the fabric shall be fastened to the top tension cable and the lower edge fastened to the bottom tension wire.
1. Tension cable and wire shall be stretched tight with truss tightener as shown on the plans.
  2. The bottom tension wire shall be installed on a straight grade between posts by excavating the high points of the ground and in no case will filling of depressions be permitted.
- H. The fabric shall be fastened to the end, corner, and gate posts with ~~one-fourth by three-fourths-inch-(1/4-inch by " x 3/4-inch"-(0.64 x 1.91-centimeters))~~ steel stretcher bars and not less than ~~one-eighth by three-fourths-inch-(1/8-inch by " x 3/4-inch"-(0.32 x 1.91-centimeters))~~ steel stretcher bar bands placed at ~~one-(1)-~~foot ~~(30-centimeters)~~ intervals, and to line posts, tension cable, and tension wires with tie wires or metal bands. Tie wires or metal bands shall be spaced on line posts at intervals of approximately ~~fourteen-(14)~~ inches ~~(36-centimeters)~~ and on tension cable and tension wires approximately ~~eighteen-(18)~~ inches ~~(46-centimeters)~~.
- I. All posts shall be fitted with tops designed to fit securely over the posts, and carry the top tension cable, except that the top of the C-~~S~~section posts may be open-slotted to securely hold the top tension cable in position without vertical movement.
1. ~~Such~~The slotting shall allow removal and replacement of a post without disturbing the top tension cable.
  2. Tubular posts shall be fitted with watertight tops.

#### 616.03.04 RECONSTRUCT FENCE

- A. Reconstructed fences shall be carefully erected, using salvaged materials and shall be similar in type to the original construction.



## FENCING

616

- B. ~~Any new~~ New materials necessary to rebuild the fence shall be furnished by the Contractor, and shall be of the same kind as those in the original fence. ~~and the~~ The cost ~~thereof~~ such new materials shall be included in the contract price for the work.
- C. The resulting reconstructed fence shall be equal to or better than before removed.
- D. In reconstructed fences, the Contracting Agency reserves the right to furnish the Contractor with such new materials as the Contracting Agency deems advisable, and these materials shall be used in the reconstruction of the fence in lieu of salvaged materials which they materials replaced.

**616.03.05 GATES**

- A. The width of drive gates shall be as shown on the plans and as indicated in the proposal and the height shall be suited to the fencing but shall not be more than ~~seventy-two (72) inches (1.83 meters)~~ nor less than ~~forty-eight (48) inches (1.22 meters)~~.
- B. The wire mesh filler shall be rectangular or ~~two (2)-inch (5 centimeters)~~ diamond mesh for standard fencing and chain-link fence fabric for chain-link fencing.
- C. Walk gates shall be of the width shown on the plans or in the ~~s~~Special ~~p~~Provisions and of a height corresponding to the adjacent fence height.
- D. The gates shall be hung by steel or malleable iron hinges ~~so~~ designed ~~as~~ to securely fasten to the gate posts and permit the gate to swing back against the fence.
- E. Gates shall be provided with a combination steel or malleable iron catch and locking-in attachment of approved design. A center rest with catch shall be provided where required.
- F. Missouri gates shall be constructed as shown on the standard plans.

## METHOD OF MEASUREMENT

**616.04.01 MEASUREMENT**

- A. The quantity of new fence measured for payment will be the number of linear feet ~~(meter)~~, exclusive of gates and cattle guards, complete and in place.
- B. The quantity of reconstructed fence measured for payment will be the number of linear feet ~~(meter)~~, including used gates complete and in place.
- C. The quantity of new gates measured for payment will be the number of gates complete and in place. If more than ~~one~~ 1 size or type of gate is involved, separate measurement will be made for each size and type given.
- D. Missouri gates, regardless of width, shall be measured for payment as units.
- E. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**616.05.01 PAYMENT**

- A. The accepted quantity of new and reconstructed fence measured as provided in Subsection 616.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~ for the types and sizes specified.

616

## FENCING

- B. The accepted quantity of new gates measured as provided in Subsection 616.04.01, "Measurement," will be paid for at the contract unit price bid per each for types and sizes specified.
- C. The above prices shall be full compensation for furnishing hardware, cement concrete, framing, erecting, connecting fence, and all incidentals necessary to complete the work.
- D. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- E. Payment will be made under:

**PAY ITEM****PAY UNIT**

Type ( ) Fence .....	Linear Foot <del>(Meter)</del>
(Size) Chain-Link Fence .....	Linear Foot <del>(Meter)</del>
(Size) Metal Drive Gate .....	Each
(Size) Timber Drive Gate .....	Each
(Size) Metal Walk Gate .....	Each
(Size) Timber Walk Gate .....	Each
Reconstruct Fence .....	Linear Foot <del>(Meter)</del>
Missouri Gate .....	Each

**SECTION 617**  
**CATTLE GUARDS**  
 DESCRIPTION

**617.01.01 GENERAL**

- A. This work shall consist of furnishing and constructing standard steel cattle guards and cattle guard wings of the design and at points shown on the plans ordered by the Engineer.

**MATERIALS**

**617.02.01 GENERAL**

- A. All materials shall conform to the requirements specified in the following sections:

<b>Materials</b>	<b>Section</b>
Portland Cement Concrete	501
Reinforcing Steel	505
Steel Structures	506
Hardware	723
Painting	614
Paint <a href="#">and Pavement Markings</a>	714
Timber	718

- B. All hardware shall be galvanized steel.
- C. All lumber and timber shall be Douglas Fir, No. 2 joist and plank or No. 1 structural posts and timber. Any commercial grading rules that will provide material of an equal or greater stress value may be used.

**CONSTRUCTION**

**617.03.01 EARTHWORK**

- A. Structure excavation and backfill shall conform to ~~the applicable requirements of~~ Section 206, "Structure Excavation," and [Section 207](#), "[Structure](#) Backfill."

**617.03.02 GENERAL**

- A. Cattle guards shall be constructed in accordance with the details and dimensions shown on the plans.
- B. Concrete and metal reinforcement construction shall conform to ~~the applicable requirements of~~ Sections 502, "Concrete Structures," and [Section 505](#), "Reinforcing Steel," respectively.
- C. Steel members ~~s~~ connections shall be welded and ~~the construction thereof shall conforming~~ [ing](#) to Section 506, "Steel Structures."
- D. The wing posts and wheel guards shall be given a preservative treatment conforming to ~~the requirements of~~ Section 719, "Timber Preservatives." Treated timber and lumber ~~is~~[shall](#) not ~~to~~ be painted.

617

## CATTLE GUARDS

- E. Timber and lumber shall be assembled and placed in conformance ~~to the applicable requirements of~~ with Section 507, "Timber Structures."
- F. Painting shall be in accordance with recognized high standards of workmanship and in conformance with ~~the applicable requirements of~~ Section 614, "Painting."

## METHOD OF MEASUREMENT

**617.04.01 MEASUREMENT**

- A. The quantity to be measured for payment will be the number of cattle wings, and steel cattle guards complete and in place. If more than one size of cattle guard is involved, separate measurement will be made of each size given.
- B. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**617.05.01 PAYMENT**

- A. The accepted quantity of cattle guards measured as provided in Subsection 617.04.01, "Measurement," will be paid for at the contract unit price bid per each for the sizes specified.
  - 1. The cost of cattle guard wings shall be included in the contract unit price for cattle guards; however, where wings alone are required, they wings will be paid for at the contract unit price each for cattle guard wings.
  - 2. The above prices shall be full compensation for furnishing hardware, cement concrete, steel, timber and lumber, structure excavation and backfill, furnishing and applying paint, framing, erecting, adjusting fence, and all incidentals necessary to complete the work.
- B. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- C. Payment will be made under:

**PAY ITEM****PAY UNIT**

(Size) Steel Cattle Guard.....	Each
Cattle Guard Wings .....	Each

**SECTION 618****GUARDRAIL****DESCRIPTION****618.01.01 GENERAL**

- A. This work shall consist of furnishing and erecting new guardrail, end anchor assemblies, guardrail expansion joints, breakaway cable terminals, and additional guardrail beam elements required for constructing double beam rail, or reconstructing guardrail previously removed, in conformity with these specifications and of the types and at the points shown on the plans or ordered by the Engineer.
- B. This ~~item~~work shall also consist of furnishing and installing reflector plates as shown on the plans.

**MATERIALS****618.02.01 GENERAL**

- A. All material shall conform to the requirements specified in the following sections:

<b>Materials</b>	<b>Section</b>
Timber	<del>Section 718</del>
Timber Preservatives	<del>Section 719</del>
Guardrail Materials	<del>Section 720</del>
Galvanizing	<del>Section 715</del>

- B. Guardrail posts and blocks shall be rough construction grade and shall comply with the grading requirements of Subsection 718.03.02, "Grades."
- C. Cable end anchor assemblies for metal beam guard railing shall be constructed as shown on the plans and shall conform to ~~the requirements set forth in~~ Subsection 720.03.04, "Cable End Anchor Assemblies."
- D. Each post shall be given a preservative treatment by pressure processes with ~~one~~1 of the following in accordance with ~~the provisions of~~ Section 615, "Preservative Treatments for Timber."
- E. The minimum retention of preservative in pounds per cubic foot ~~(grams per cubic centimeter)~~ of wood shall be as follows:
1. ~~(a) Creosote - 8 pounds (0.128 grams per cubic centimeter)~~ per cubic foot.
  2. ~~(b) Creosote-Petroleum - 8 pounds (0.128 grams per cubic centimeter).~~ per cubic foot
  3. ~~(c) Pentachlorophenol - 8 pounds (0.128 grams per cubic centimeter).~~ per cubic foot
- F. Guardrail quantities shown on the plans are approximate.
1. As construction progresses, the Engineer will review the need for guardrail and will, at the completion of this review, provide the Contractor with the revised amount of guardrail required.

618

## GUARDRAIL

2. Should the Contractor elect to order guardrail materials prior to receiving this revised list from the Engineer, the Contractor shall be completely responsible for furnishing the amount of guardrail and appurtenances required by ~~said~~the list.
3. Should additional quantities be required to meet the requirements of the list, there shall be no additional compensation allowed above the unit price and no compensation shall be allowed for surplus materials in excess of the requirements of the list.

**618.02.02 REFLECTORS**

- A. Reflector plates for guardrail shall be fabricated from ~~eleven (11-) gauge (0.30 centimeters)~~ steel sheet.
  1. Nails for fastening reflector plates to the guardrail post shall be either galvanized metal or aluminum.
  2. Steel reflector plates shall be galvanized.
  3. Reflectorized material for reflector plates shall conform to ~~the requirements of~~ Subsection 721.03.03, "Reflectors."
- B. Reflector plates shall be constructed and erected on guardrail in accordance with the details shown on the plans and ~~in the Standard Sas~~ specifications, and shall be spaced as follows:
  1. ~~(a)~~ 50 feet ~~(15 meters)~~ on tangents and curves of 700 feet ~~(213 meters)~~ radius or greater.
  2. ~~(b)~~ On curves with less than 700 feet ~~(213 meters)~~ radius, markers shall be placed on the post nearest the spacing shown for guide posts ~~in Table 1,~~ as shown in the plans.
  3. ~~(c)~~ At interchanges, guardrail markers with amber reflectors shall be installed at a maximum spacing of 50 feet ~~(15 meters)~~ along acceleration and deceleration lanes, and in accordance with above subparagraph ~~2(b)~~ on turning ramps and roadways.
- C. Reflectors shall be white except as noted in subparagraph 3~~(c)~~ above.

**CONSTRUCTION****618.03.01 GENERAL**

- A. Unless otherwise specified, guardrail shall be constructed with either treated Douglas Fir, West Coast Hemlock, or Western Larch posts, beam-type plates and fittings, as shown on the plans.
  1. Post spacing shall be as shown and guardrails shall be constructed in accordance with the design shown on the plans.
  2. The use of more than ~~one~~ 1 type of guardrail on a single project will not be approved unless so provided in the ~~s~~Special ~~p~~rovisions or appearing as a contract item in the proposal.
- B. Posts shall be set plumb, except on superelevated curves where the ~~y~~ posts shall be set perpendicular to the roadbed.
  1. Front faces of posts shall form a straight line, except on curves where the ~~y~~ posts shall be a uniform distance from the centerline of the roadway.

## GUARDRAIL

618

2. Post holes shall be backfilled in layers with approved material thoroughly rammed with an iron tamping tool in such manner as not to displace the bottom of posts from correct alignment.
- C. Guardrail beam elements may be furnished in 12-foot, 6-inch ~~(3.8-meters)~~ or 25-foot ~~(7.6-meters)~~ lengths at the option of the Contractor, and shall conform to ~~the~~ AASHTO M180, requirements for "Corrugated Sheet Steel Beams for Highway Guardrail," ~~designation M-180-74, requirements~~ for Class A, Type 2 guardrail.
- D. Cable end anchor assemblies for metal beam guard railing shall be constructed as shown on the plans and as specified herein.
- E. Cable clips and a cable thimble shall be used to attach cable to the anchor rod.
- F. After installation and before backfilling, the portion of the anchor rod to be buried in earth shall be coated with a minimum 20-mil ~~(0.05-centimeters)~~ thickness of coal tar enamel conforming to AWWA ~~Standard C-203, "Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied."~~
- G. Metal components of the anchor assembly shall be fabricated in conformance with good shop practices and shall be hot-dip galvanized in accordance with ~~the provisions in~~ Section 715, "Galvanizing."
- H. Anchor blocks shall be constructed of concrete conforming to the provisions in Sections ~~501, "Portland Cement Concrete,"~~ and Section 502, "Concrete Structures."
- I. Concrete shall be placed against undisturbed material of the excavated holes for anchor blocks. The top 12 inches ~~(30-centimeters)~~ of holes shall be formed, if required by the Engineer.
- J. Surplus excavated material remaining after the guard railing has been constructed shall be disposed of in a manner satisfactory to the Engineer.
- K. The overall length of each anchor cable assembly shall be a minimum of 10 feet ~~(3 meters)~~.
- L. Framing shall be done and fittings attached ~~in such manner~~ so that the rail, after erection, shall be true to line and grade and shall have the proper tension in the rail plates.
  1. Care shall be taken to prevent the disturbance of posts during the erection of the rail, ~~and,~~
  2. ~~When~~ When necessary, temporary braces shall be installed to ~~ensure~~ ensure against post displacement.

## 618.03.02 PAINTED GUARDRAIL

A. ~~(A)~~ Field Painted:

1. After the posts are set, the exposed portions shall be wrapped or otherwise protected to the satisfaction of the Engineer so that they ~~posts~~ posts shall remain free from paint, road oil, and other objectionable material.
  - a. After all other work is completed and prior to the semi-final inspection, the wrapping or protection shall be removed.
  - b. All posts that have paint, road oil, or other objectionable materials on the exposed surface or that do not otherwise meet the required specifications shall be cleaned or removed as the case may require, at ~~the Contractor's expense~~ no additional cost to the Contracting Agency.



2. All exposed surface of the metal guardrail that has become soiled or marred shall be cleaned or repainted ~~at the expense of~~ by the Contractor as required by the Engineer, at no additional cost to the Contracting Agency.
  3. After the rail has been painted as specified, nuts fastening rail plate to springs shall be backed off slightly so that the connection is firm, but not tight, and will permit the slight movement necessary to absorb expansion and contraction of the rail.
  4. New guardrail beam elements shall be galvanized both sides, cleaned, primed, and painted on the side facing traffic.
  5. After erection, all metals parts and fittings, ~~shall be~~ free from coatings of any kind, including dirt, rust, and oil and grease, and shall be given ~~three~~ 3 coats of paint as specified in Section 714, "Paint and Pavement Markings."
  6. Parts shop prime coated by the manufacturer shall conform to Subsection 614.03.04, "Painting Structural Steel," and Section 714, "Paint and Pavement Markings."
  7. Posts shall not be painted.
  8. All beams shall be cleaned prior to priming by wiping down the surface with solvents such as naphtha, white (lead-free) gasoline, or detergent.
    - a. Detergents may be of the type commonly used in washing machines.
    - b. ~~however, if~~ detergent is used, it shall be thoroughly rinsed from the rail with clear water.
  9. All loose white deposit shall be removed with a stiff brush (not steel), steel wool, or sandpaper. Care shall be exercised ~~so as~~ not to remove zinc coating.
  10. Prime coat may be applied in the field and shall conform to ~~California State Specification 701.80.52, "Pre-Treatment Vinyl Wash Primer."~~ MIL-P-21035.
  11. Intermediate and finish coats shall conform to ~~California State Specification 741.80.10, "Exterior White Metal Enamel."~~ MIL-P-21035.
  12. Surfaces to be painted shall be dry and the temperature during priming, painting, and for ~~six (6)~~ hours thereafter shall not be below ~~fifty (50) degrees Fahrenheit (10 degrees Celsius)~~.
- B. ~~(B)~~ **Prepainted:**
1. Guardrail beam elements may be cleaned, primed, and prepainted on the side facing public traffic by the manufacturer prior to delivery to the jobsite as hereinafter specified.
  2. ~~(a)~~ **Cleaning:**
    - a. All beam elements shall be alkaline cleaned, mechanically brushed, rinsed, given a zinc phosphate coating with a nominal coating weight of 200 mg- per square foot ~~(930 square centimeter)~~, rinsed, and neutralized.
    - b. Metal preparation ~~to~~ shall comply with Military Specification MIL-T-12879, Type I, Class 1.
  3. ~~(b)~~ **Priming and Painting:**
    - a. Prime coat shall be vinyl type, containing corrosion inhibiting pigment, applied at a nominal dry film thickness of 0.50 mil ~~(0.0013 centimeters)~~.

## GUARDRAIL

618

- b. Finish coat shall be a high gloss white thermosetting acrylic, baked enamel, applied at 1.0 mil (~~-.0025-centimeter~~) nominal. The white pigment ~~used to~~shall be non-chalking type.
- c. All exposed surface of the metal guardrail that has become soiled or marred shall be cleaned or repainted, ~~at the expense of~~ by the Contractor, as required by the Engineer, at no additional cost to the Contracting Agency.

**618.03.03 ~~618.03.04~~ RECONSTRUCTED GUARDRAIL**

- A. Reconstructed guardrail shall be carefully erected using salvaged materials and shall be similar in type to the original construction.
- B. Any new materials necessary to rebuild the guardrail shall be furnished by the Contractor, and shall be of the same kind as those in the original if available, ~~and t~~ The cost thereof such new materials shall be included in the contract price for the work.
- C. The Contracting Agency reserves the right to furnish the Contractor with such materials as ~~the Contracting Agency~~ deems advisable, and these materials shall be used in the reconstruction of the guardrail in lieu of salvage materials which they materials replaced.
- D. Reconstructed guardrail shall be painted with ~~one~~ 1 coat of paint after first touching up all spots on which the original paint has been removed or destroyed.

## METHOD OF MEASUREMENT

**618.04.01 MEASUREMENT**

- A. The quantity of new or reconstructed guardrail measured for payment will be the number of linear feet (~~meters~~) measured along the front face of the rail between centers of end posts or between center of end post and bridge connections, as the case may be applicable, complete and in place. In the case of new guardrail, an allowance of two (2) feet (0.6 meters) at each end post shall be added to the length measured between the centers of end posts when terminal sections are specified. The length of expansion joints will be included in the measurement.
- B. The quantity of cable end anchors constructed will be measured for payments ~~s~~ as units.
- C. The quantity of guardrail expansion joints constructed will be measured for payment as units.
- D. The additional guardrail beam elements required to construct the double beam rail at locations shown on the plans shall be measured for payment by the linear foot (~~meter~~) measured along the face of the additional rail between centers of end posts.
- E. Breakaway cable terminals will be measured for payment as units.
- F. Where breakaway cable terminals are installed, guardrail measurements will not include the terminal ends.
- G. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

## BASIS OF PAYMENT

**618.05.01 PAYMENT**

- A. The accepted quantity of new and reconstructed guardrail measured as provided in Subsection 618.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot ~~(meter)~~.
- B. The above prices shall be full compensation for furnishing hardware, reflectors, erecting, painting, galvanizing, and all incidentals necessary to complete the work.
- C. The accepted quantity of "Cable End Anchors" measured as provided above will be paid for at the contract unit price bid per each, which ~~price~~ shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing cable and anchors, complete in place, including drilling anchor plate bolt holes in rail elements, excavating anchor block holes, backfilling, and disposing of surplus material, as shown on the plans, as specified in these specifications, and as directed by the Engineer.
- D. The accepted quantity of "Guardrail Expansion Joints" measured as provided will be paid for at the contract unit price bid per each, which ~~price~~ shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing the expansion joints complete in place.
- E. The accepted quantity of "(Type) Guard Rail Beam Elements" measured as provided above will be paid for at the contract unit price bid per linear foot (meter) of double beam rail, which ~~price~~ shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing the double beam rail complete in place.
- F. Breakaway Cable Terminal will be paid for at the contract unit price bid per each, which ~~payment~~ shall be considered full compensation for the terminal element and diaphragms, terminal connector, cable, fittings, straps, anchor plate, bolts, nuts, washers, structure excavation, concrete, reinforcement, and redwood, and for doing all the work involved to install the breakaway cable terminal complete in place in the accepted work.
- G. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- H. Payment will be made under:

**PAY ITEM****PAY UNIT**

Painted Guardrail .....	Linear Foot <del>(Meter)</del>
Reconstruct Guardrail .....	Linear Foot <del>(Meter)</del>
Cable End Anchors .....	Each
Guardrail Expansion Joints .....	Each
(Type) Guard Rail Beam Elements .....	Linear Foot <del>(Meter)</del>
Breakaway Cable Terminal .....	Each

**SECTION 619****OBJECT MARKERS AND GUIDE POSTS****DESCRIPTION****619.01.01 GENERAL**

- A. This work shall consist of furnishing and installing object markers and guide posts of the design and at locations shown on the plans or established by the Engineer.

**MATERIALS****619.02.01 GENERAL**

- A. Materials shall conform to ~~the requirements specified in~~ Section 721, "Object Markers and Guide Posts."

**CONSTRUCTION****619.03.01 GENERAL**

- A. Target members, object markers, and reflectors appropriate to the color involved shall be assembled, fastened, set, and aligned in accordance with the details and dimensions shown on the plans.
- B. All fastenings shall be tight.

**619.03.02 RESET**

- A. Reset object markers and guide posts shall be erected, using salvaged materials, and shall be similar in type to the original construction.
- B. Any new materials necessary to rebuild the markers shall be furnished by the Contractor, shall be the same as those in the original, if available, and the cost thereof shall be included in the contract price for the work.
- C. The Contracting Agency reserves the right to furnish the Contractor with such new materials as ~~it~~ the Contracting Agency deems advisable, and these materials shall be used in the resetting of the markers in lieu of salvage materials which they ~~y~~ materials replaced.

**METHOD OF MEASUREMENT****619.04.01 GENERAL**

- A. The quantity of new or reset object markers or guide posts measured for payment will be the number of markers or guide posts ordered by the Engineer and placed by the Contractor.
- B. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

619

## OBJECT MARKERS AND GUIDE POSTS

## BASIS OF PAYMENT

**619.05.01 PAYMENT**

- A. The accepted quantity of new and reset object markers and guide posts measured as provided in Subsection 619.04.01, "Measurement," will be paid for at the contract unit price bid per each, which ~~price~~ shall be full compensation for furnishing hardware, erecting, and incidentals to complete the work.
- B. When the Engineer orders guide posts placed for the protection of the public traffic, and ~~such~~ the Engineer's order is prior to the time the Contractor would normally install the ~~m~~ guide posts, and some posts subsequently are damaged by public traffic, the Contractor shall replace the damaged posts with new ones and receive compensation at the contract unit price for both the damaged posts and the ~~ones~~ posts replaced.
- C. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- D. Payment will be made under:

<b>PAY ITEM</b>	<b>PAY UNIT</b>
Guide Posts .....	Each
Reset Guide Posts .....	Each
Object Markers, Type 1 .....	Each
Object Markers, Type 2 .....	Each
Object Markers, Type 3 .....	Each
Reset Object Markers .....	Each

**SECTION 620****RIGHT-OF-WAY MARKERS****DESCRIPTION****620.01.01 GENERAL**

- A. This work shall consist of furnishing and erecting metal posts and plates for right-of-way markers conforming to these specifications and of the design shown on the plans or ordered by the Engineer.

**MATERIALS****620.02.01 GENERAL**

- A. All materials shall conform to the requirements specified in ~~the following sections:~~ Section 721, "Object Markers and Guide Posts" ~~Section 721.~~

**CONSTRUCTION****620.03.01 GENERAL**

- A. Right-of-way markers shall be constructed in accordance with the details and dimensions shown on the plans.
- B. The markers shall be set plumb.
- C. The exact location of posts will be staked by the Engineer.

**METHOD OF MEASUREMENT****620.04.01 MEASUREMENT**

- A. The quantity of right-of-way markers measured for payment will be the number of markers complete and in place.
- B. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

**BASIS OF PAYMENT****620.05.01 PAYMENT**

- A. The accepted quantity of right-of-way markers measured as provided in Subsection 620.04.01, "Measurement," will be paid for at the contract unit price bid per each.
- B. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- C. Payment will be made under:

**PAY ITEM****PAY UNIT**

Right-of-~~w~~Way Markers ..... Each

**SECTION 621****MONUMENTS****DESCRIPTION****621.01.01 GENERAL**

- A. This work shall consist of furnishing and installing permanent survey monuments, constructed in accordance with the design and drawings shown on the plans or ordered by the Engineer.
- B. Bronze discs as specified by the Contracting Agency shall be installed and inscribed in the monuments under the direct supervision of a Registered Land Surveyor.
- C. The Contractor shall coordinate ~~his~~Contractor's work with the Registered Land Surveyor.

**MATERIALS****621.02.01 GENERAL**

- A. Monuments shall be constructed of Portland cement concrete, and shall be of Type I, Type II, Type III, or Type IV as shown in the Standard Drawings.

**CONSTRUCTION****621.03.01 INSTALLATION**

- A. The monuments shall be set to assist in reestablishment of the center line for future use and shall be set at the beginning and end of each project, at the beginning and end of each curve, at any angle point, at street intersections, and to replace or reference Section Corners or other Government Land Corners.
- B. The monuments may perpetuate a point or reference a point.
- C. An ~~as-~~built set of plans for the project, showing the exact location of all monuments set, shall be prepared by a Registered Land Surveyor and filed with the County Surveyor prior to acceptance of the project.

**METHOD OF MEASUREMENT****621.04.01 MEASUREMENT**

- A. The quantity of monuments measured for payment will be the number of units complete and in place.

**BASIS OF PAYMENT****621.05.01 PAYMENT**

- A. The accepted quantity of monuments measured as provided in Subsection 621.04.01 will be paid for at the contract price bid per each.
- B. Payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- C. Payment will be made under:



621

MONUMENTS

**PAY ITEM**

**PAY UNIT**

Monuments ..... Each