| Standard Specifications Manual |
| --- |
| SERIES 700 - INCIDENTAL CONSTRUCTION |

Item No.

**ITEM NO. 700**
**MOBILIZATION**

## 700.1 Description

This item shall govern the mobilization of personnel, equipment and materials at the work site for other contract items that will be performed by the Contractor. Mobilization shall include, but not be limited to the movement of equipment, personnel, material, supplies, etc. to the Work site; the installation of temporary facilities (when not paid for separately) and the establishment of office and other necessary facilities prior to the initiation of the Work. The cost of the Payment Bond and Performance Bond on the Work that is delayed due to circumstances beyond Contractor's control, a closed construction season or for the convenience of the Owner/Developer will be considered part of the mobilization item under this Contract.

## 700.2 Measurement

Measurement of the Specification Item, "Mobilization", as specified herein as "Total Mobilization Payment", will be by the "Lump Sum", as the Work progresses.

## 700.3 Payment.

The adjusted contract amount as used below is defined as the original contract amount less the lump sum bid for Mobilization and any payments for materials or equipment not yetincorporated in the Work. The Contractor shall submit a lump sum amount for Payment Item "Total Mobilization Payment".

"Initial Mobilization Payout" as used below is defined as:

1. 8% of the original contract amount for projects with an original contract amount of $ 0.5 million or less; or
2. 4% of the original contract amount for projects with an original contract amount greater than $ 0.5 million.

In those instances where the "Initial Mobilization Payout", as defined above, exceeds the "Total Mobilization Payment" lump sum bid item "Total Mobilization Payment" shall be used as the "Initial Mobilization Payout". In no instance shall the "Initial Mobilization Payout" exceed the "Total Mobilization Payment" bid item.

Partial payments of the "Initial Mobilization Payout" shall be as follows:

A. Upon presentation of a paid invoice for the Payment Bond, Performance Bond and/or required insurance, the Contractor will be paid that cost from the amount bid for "Total Mobilization Payment".

B. The Mobilization of tunnel boring machines, batch plants or other similar facilities, along with supporting materials and equipment, to the work site or to the vicinity of the Work site will be considered as partial Mobilization under this contract. The Contractor shall provide a certified statement of his expenditure for the Mobilization and setup of the facility and supporting equipment. Upon approval by the Engineer or designated representative, the certified expenditure will be paid from the amount bid for the Specification Item, "Total Mobilization

Payment". In no case shall the combined amount for all of these facilities be more than 10 percent of the "Total Mobilization Payment" lump sum bid or one (1) percent of the total contract amount, whichever is less.

C. When one (1) percent of the adjusted contract amount is earned, 50 percent of the "Initial Mobilization Payout" will be paid. Previous payments under this item will be deducted from this amount.

D. When five (5) percent of the adjusted contract amount is earned, seventy-five (75) of the "Initial Mobilization Payout" will be paid. Previous payments under this item will be deducted from this amount.

E. When ten (10) percent of the adjusted contract amount is earned, one hundred (100) percent of the "Initial Mobilization Payout" will be paid. Previous payments under this item will be deducted from this amount.

F. Payment for the remainder of Pay Item "Total Mobilization Payment" will be made upon receipt of the final pay estimate.

Payment will be made under:

| | |
|---|---|
| "Total Mobilization Payment" | Lump Sum |

**End**

**ITEM NO. 701**
**FENCING**

## 701.1 Description

This item shall govern furnishing and installing fencing and gates at locations shown on the Drawings or directed by the Engineer or designated representative, including all posts, bracing and accessories as specified in this Item and as indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

## 701.2 Submittals

Prior to installation of the fencing the Contractor shall furnish the Engineer or designated representative with certification from the manufacturer that all fencing materials comply with the requirements specified in this Item.

## 701.3 Materials

A. Chain Link Fabric

1. Wire fabric for fencing shall be 9 gauge (3.76 mm) steel with a minimum breaking strength of 1,290 pounds per foot (1 750 Newtons per meter). The overall height of the fence when erected shall be the height above grade as indicated on the Drawings. The fabric shall be woven into an approximately 2-inch ± 1/8-inch (50 mm ± 3 mm) mesh such that in a vertical dimension of 23 inches (585 mm) along the diagonals of the openings there shall be at least 7 meshes. Unless indicated otherwise on the Drawings the fabric shall have a knuckled (K) and twisted (T) finish for the top and bottom selvages respectively. The wire in the fabric shall withstand a minimum tensile strength test of 75,000 psi (517 kPa) after galvanizing. Except as provided herein, the chain link fence fabric shall conform to ASTM A392, Class I or ASTM A491.

2. The fabric shall be hot dip galvanized after weaving and shall have a minimum coating of 1.2 ounces per square foot (0.4 kilograms per square meter) of uncoated surface conforming to ASTM A392, Class I.

3. Between posts the fabric shall be fastened at 12-inch (300-mm) intervals to a top and bottom tension wire. When a top rail is shown on the Drawings, the fabric shall also be fastened in the same manner. On gate frames, the fabric shall be fastened to top and bottom of the gate frame at all 12-inch (300-mm) intervals. Steel or aluminum wire fabric ties with a minimum 9 gauge (3.76 mm) diameter shall be used.

B. Woven Wire Fencing

Woven wire fencing shall be either galvanized steel wire fencing or aluminum-coated steel wire fencing conforming to the following requirements:

1. Galvanized steel wire fencing shall conform to ASTM A116, Class 1.

2. Aluminum-coated steel wire fencing shall consist of aluminum-coated steel wire conforming to the requirement for galvanized steel wire fencing, except the wire shall be aluminum coated. The wire shall not have less than 0.40 ounce (11 grams) coating of aluminum alloy per square foot of uncoated surface in accordance with ASTM A491

C. Wire Fencing

Wire shall be either galvanized or aluminum alloy coated 9 gage (3.76 mm) steel wire conforming to the specifications for galvanized steel or aluminum alloy coated woven wire fencing above.

D. Wood Fencing

Wood for wood fencing shall be Wolmanized pine, cedar or as indicated on the Drawings. The timber shall be sound and free from all decay, shakes, splits or any other defects, which would make it structurally unsuitable for the intended purpose.

E. Metal Posts, Top Rails, Braces and Gates

Steel pipe used for posts, top rails, braces and gate frames shall conform to the specifications of ASTM A 53. Steel sections used for posts, top rails, frames and braces shall be a good commercial quality weldable steel. All material shall be new and no used, re-rolled or open seam material will be acceptable. All posts shall meet the weight and length requirements indicated. The fabric bands and steel wire ties shall conform to the gauge and spacing indicated and shall be of suitable design to fasten fabric to the posts. Wire ties of the gauge shown may be used in lieu of fabric bands. All fittings required for posts shall be pressed or rolled steel, forge steel, malleable iron or wrought iron of good commercial quality and spaced as indicated on the Drawings.

1. Line Posts

Line posts may be either C-section or tubular. Tubular line posts shall be fitted with watertight malleable iron caps. Line posts shall be furnished in sufficient quantity to provide a maximum spacing of 10 feet (3 meters)

2. Terminal Posts

All end, corner and pull posts shall be known as terminal posts and shall be of either round or square sections. All terminal posts shall be furnished with watertight malleable iron caps. Fabric shall be fastened to terminal posts by steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing indicated on the Drawings.

3. Gate Posts

Gate posts shall be either round or square. All gate posts shall be furnished with watertight malleable iron caps. The fabric shall be attached to the gate posts by means of steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing indicated on the Drawings.

4. Post Caps

Post caps for pipe sections shall be designed to exclude all moisture. Where a top rail is shown on the Drawings, post caps shall have an opening for the top rail. All post caps shall have a 2-inch (50-mm) skirt for rigidity. When barbed wire is allowed for topping a six-foot (1.82 meter) or higher fence, the barbed wire support arms shall be integral with post caps.

5. Gates

The gate frames shall be fabricated from sections either round or square of the size and weight indicated on the Drawings and shall be filled out with the same type fabric specified for the chain link fence. All gates shall be equipped with approved malleable iron or steel latches, stops and center rest. A satisfactory locking device suitable for padlocking shall be provided. The gates shall be hung by at least 2 steel or malleable iron hinges securely fastened to the posts. Hinges shall not twist or turn under the action of the gate, shall be capable of allowing a full 180 degree opening turn, shall be so arranged that a closed gate cannot be lifted off the hinges to obtain entry and shall be easily operated by one person.

6. Top Rail

The top rail shall be of size and weight indicated on the Drawings and shall be furnished in random lengths, not less than 18 feet (5.5 meters) per section with outside sleeve type couplings at least 6 inches (150 mm) long and having a wall thickness of not less than 0.70-inch (18-mm). One coupling in five shall have a heavy spring to take up expansion and contraction of the rail. The top rail shall be installed before installing chain link fabric and shall pass through post tops.

7. Braces

All braces shall be of the size, weight and length indicated on the Drawings. All braces shall be trussed with rods and turnbuckles of the dimensions indicated on the Drawings. Braces shall be installed on all terminal posts and shall extend to the adjacent line posts. All corner and pull posts shall have braces on each side of terminal.

8. Fittings, Bolts and Other Miscellaneous Hardware

All fittings, bolts and miscellaneous hardware shall be hot dip galvanized in conformance with TxDoT Standard Specification Item No. 445, “Galvanizing”.

9. Tension Wire

Between posts, the fabric shall be fastened to a top and bottom tension wire or to the top rail and bottom tension wire by steel wire ties of the gauge and spacing

indicated on the Drawings. The tension wire shall be at least 7 gauge (4.5 mm) galvanized coil spring steel of good commercial quality.

Tension wire shall have a minimum coating of 0.8 ounce per square foot (0.2 kilogram per square meter) of uncoated surface when tested in conformance with ASTM A116.

10. Security Fence

The security fence shall be 8 feet (2.44 meters) high with brackets and 3 strands barbed wire.

Barbed wire, when specified on the Drawings, shall be 12-1/2 gauge wire (2.51 mm), twisted with two-point 14 gauge (2.03 mm) barbs spaced approximately 5 inches (125 mm) apart and shall conform to ASTM A121 or ASTM A585. Three strands of barbed wire will be required when a barbed wire top is specified on the Drawings.

Barbed wire support arms shall be at an angle or 45°from vertical and shall have clips for attaching three (3) strands of barbed wire to each support arm. Each support arm shall be of sufficient strength to support a 200-pound (90 kilograms) weight (mass) applied at the outer strand of barbed wire.

11. Galvanizing

Thin-wall, high-strength pipe posts shall be externally hot-dip galvanized with a minimum weight of coating of 0.9 ounce per square foot (0.3 kilogram per square meter). After galvanizing, thin-wall, high-strength pipe posts shall be externally chromated by total immersion followed by application of clear polyurethane finish.

Interior surfaces shall have a hot-dip galvanized coating, a zinc base coating with thickness 0.5 mil ± 0.2 mil (13 micrometer ± 5 micrometer). The coating shall be 94 percent zinc powder by weight (mass).

All tubular posts, rails and braces shall comply with the following salt spray performance requirements when tested in accordance with ASTM B117.

Exterior 1250 hours to maximum 5 % red rust

Interior 650 hours to maximum 5 % red rust

The uniformity of the zinc coating shall be determined by visual inspection. If, in the opinion of the Engineer or designated representative, visual examination is not conclusive, he may use the Preece Test as described in ASTM A239. When so tested, all items shall withstand a minimum of 6 one-minute dips except for those items designated in ASTM A153 as Class B-2, B-3, C and D, which shall withstand a minimum of 4 one-minute dips.

Careful visual inspection shall be made to determine the quality of the zinc coating. Excessive roughness, blisters, salammoniac spots, bruises and flaking if present to any considerable extent, shall provide a basis for rejection. Where practicable, all inspection and tests shall be made at the place of manufacturer prior to shipment and shall be so conducted as not to interfere unnecessarily with the progress of the work.

Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld-burner spelter coating. The cleaned area shall be painted with 2 coats of zinc oxide-zinc dust paint conforming to the requirements of Federal Specification TT-P-641B. The paint shall be furnished at the Contractor's expense.

F. Concrete Post Anchorages

Concrete for post footings, catch blocks, anchors and other such items related to the fence construction, shall be Class B Concrete conforming to Item No. 403, "Concrete for Structures" or as indicated on the Drawings. Maximum size of aggregate shall be 3/4 inch (19 mm). Hand mixing of concrete will be permitted on batches under 1/2 cubic yard (0.38 cubic meter). All batches exceeding this volume will be machine mixed.

Concrete shall be placed promptly and without segregation after mixing. The Contractor shall consolidate the concrete satisfactorily by tamping or vibrating. Excess excavation from footings shall be satisfactorily disposed of.

The tops of post footings shall extend slightly above ground and shall be steel troweled to a smooth finish sloped to drain away from posts. Posts, braces and other units shall be centered in footings.

### 701.4 Inspection and Sampling

The Contractor shall furnish, upon request of the Engineer or designated representative, samples of each component part of the fence including fittings. These samples shall be subjected to the galvanizing, weight and where required, strength tests. A sample may be taken for each project or for each shipment to a project, when requested by the Engineer or designated representative. All samples shall be furnished to the Owner/Developer free of charge.

If any specimen tested fails to meet the requirements of this specification, two (2) additional specimens shall be cut from the remainder of the sample and tested, both of which shall meet the requirements in every respect or the lot represented by the sample may be rejected.

### 701.5 Construction Methods

The Chain Link Fence shall be erected to lines and grades established by the Engineer or designated representative in accordance with the details indicated on the Drawings. The fence shall be true to line, taut and shall comply with the best practice for fence construction of this type.

A. Clearing and Grading

The Contractor shall perform all clearing of brush, rocks and debris necessary for the installation of this fencing.

B. Erection of Posts

Posts shall be set plumb and permanently positioned and anchorages firmly set before fabric is placed. Posts shall be set in concrete, unless otherwise indicated on the Drawings.

Concrete footings shall be carried to the depth and dimensions indicated on the Drawings. Where rock is encountered within the required depth to which the post is to be erected, a hole of a diameter slightly larger than the largest dimension of the post may be drilled into the rock and the post grouted in. The regular dimensioned concrete footing as indicated on the Drawings shall then be placed between the top of the rock and required grade indicated on the Drawings. Posts shall be approximately centered in their footings. All concrete shall be placed promptly and compacted by tamping or other approved methods. Concrete shall be finished in a dome and shall be cured a minimum of 48 hours before further work is done on the posts.

Pull posts shall be placed not over 500 feet (15.25 meters) apart in straight runs and at each vertical angle point, all as directed by the Engineer or designated representative. Corner posts shall be placed at each horizontal angle point greater than 15 degrees. Corner and pull posts shall have horizontal braces and tie rods as specified above and as indicated.

C. Erection of Top Rail and Tension Wire

The top rail and bottom tension wire and/or top and bottom tension wires shall be installed before installing the chain link fabric. The top rail shall be firmly attached in final position. Tension wires shall be within 4 inches (100 mm) of the top and bottom of the fabric and shall be pulled taut.

D. Erection of Fabric

After all posts have been permanently positioned and anchorages firmly set with the cables drawn taut with the turnbuckles, the fabric shall be placed by securing one end and applying sufficient tension to the other end to remove all slack before making attachments. Unless otherwise indicated on the Drawings, the fabric shall be cut and each span shall be attached independently at all corner posts and pull posts.

Fabric shall be fastened as indicated on the Drawings and the bottom of the fabric shall be placed a normal distance of 2 inches (50 mm) above the ground line; however, over irregular ground this distance may vary between 1 inch (25 mm) and 6 inches (150 mm) for a distance not to exceed 8 feet (2.44 meters). Any necessary backfilling required, in order to comply with these provisions, will be considered as incidental work.

E. Fence Grounding

This fence shall be grounded where a power line passes over the fence. In any case, a ground shall be provided at locations not to exceed 1,000 feet (30 meters) apart in straight runs of fence. Each individual section of fence shall have at least 1 ground. The ground shall consist of a copper-weld rod 8 feet

(2.44 meters) long and a minimum of 5/8 inch (16 mm) in diameter driven or drilled in vertically until the top of the rod is approximately 6 inches (150 mm) below the top of the ground. A No. 6 solid copper conductor shall be brazed to the rod and to the fence in such a manner that each element of the fence is grounded.

F. Erection of Wood Fencing Material

After all posts have been permanently positioned and anchorages firmly set, stringers shall be placed and boards secured to the stringers. Other techniques utilizing modular precut panels may be used, when indicated on the Drawings.

**701.6 Measurement**

Fence, of each height and type specified, will be measured by the lineal foot of fence measured at the bottom of the fabric along the centerline of fence from center to center of terminal posts, excluding gates. Gates will be measured as each gate, complete in place.

**701.7 Payment**

The work performed and material furnished as prescribed by this item, measured as provided under "Measurement" will be paid for at the unit bid price for "Fence" of the height and type specified. The unit bid price shall include full compensation for furnishing and installing all fencing materials (except gates) including all miscellaneous fittings, braces, post caps, line wires, connection clips or wires; digging post holes and grouting in rock where required; furnishing and placing concrete for setting posts; furnishing and installing all electrical grounds; all hauling and handling charges; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work, including excavation, backfilling and disposal of surplus material.

Gates measured as provided under "Measurement" will be paid for at the unit bid price for "Pedestrian Gate" or "Vehicular Gate", of the type, height and opening specified. The unit bid price shall include full compensation for furnishing all materials; fabricating, preparation, hauling, handling charges and erecting, including all miscellaneous fittings, braces, latches, gate hinges, stops and center anchorage; and for all manipulations, labor, tools, equipment and incidentals necessary for complete installation.

Payment will be made under one of the following:

| | |
|---|---|
| Chain Link Fence, - | Per Lineal Foot. |
| Chain Link Pedestrian Gate, ___Foot. x __Foot. | Per Each. |
| Chain Link Vehicular Gate, ____Foot. x ___Foot. | Per Each. |
| Wire Fence | Per Lineal Foot. |
| Wood Fence | Per Lineal Foot. |
| Wood Fence Pedestrian Gate, ___Foot. x __Foot. | Per Each. |
| Wood Fence Vehicular Gate, ___Foot. x ___Foot. | Per Each. |
| Security Fence, ___Foot, High Type ___ | Per Lineal Foot. |
| Temporary Fence, ___Foot High, ____Type | Per Lineal Foot. |

**End**

| ***SPECIFIC*** CROSS REFERENCE MATERIALS |
|---|
| Specification 701, “FENCING” |

City of Round Rock Standard Specifications

| **Designation** | **Description** |
|---|---|
| Item No. 403 | Concrete for Structures |

Texas Department of Transportation: Standard Specifications For Construction of Highways, Streets and Bridges

| **Designation** | **Description** |
|---|---|
| Item No. 445 | Galvanizing |

American Society For Testing And Materials (ASTM)

| **Designation** | **Description** |
|---|---|
| A 53/A 53M | Specification For Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| A 116 | Specification For Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric |
| A 121 | Specification For Zinc-Coated (Galvanized) Steel Barbed Wire |
| A 153/A 153M | Specification For Zinc-Coated (Hot-Dip) on Iron and Steel Hardware |
| A 239 | Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron and Steel Articles |
| A 392 | Specification For Zinc-Coated Steel Chain-Link Fence Fabric |
| A 491 | Specification For Aluminum-Coated Steel Chain-Link Fence Fabric |
| A 585 | Specification For Aluminum-Coated Steel Barbed Wire |
| B 117 | Practice for Operating Salt Spray (Fog) Apparatus |

Federal Specification TT-P-641B

| ***RELATED*** CROSS REFERENCE MATERIALS |
|---|
| Specification 701, “FENCING” |

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

| **Designation** | **Description** |
|---|---|
| Item No. 550 | Chain Link Fence |
| Item No. 552 | Wire Fence |

**ITEM NO. 702**
**REMOVAL AND RELOCATION OF EXISTING FENCES**

## 702.1 Description

This item shall govern the removal and relocation of existing fence, gates and hardware to a new alignment at the location in conformance to the typical details indicated on the Drawings or as directed by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

## 702.2 Removal of Existing Materials

The existing boards, fabric, posts, wire, rails, braces, hardware, gates and miscellaneous items shall be carefully removed, bundled, rolled and stockpiled as indicated on the Drawings for installation at the new fence assignment. The removal and handling shall be such that the fence materials may be reused in the relocated fence.

A. Removal of Fabric and Wire

Fabric and wire of all types shall be carefully untied or disassembled from the posts and other appurtenances and shall be rolled in bundles of a size that will allow handling with ordinary equipment.

B. Removal of Posts

Posts shall be carefully removed from the ground and the concrete footing removed. The concrete shall be disposed of off site. Post holes shall be filled with suitable embankment material and thoroughly compacted.

C. Removal of Boards

Boards of all types shall be carefully disassembled from the rails and other appurtenances to facilitate removal in panels. Excess material removed shall be disposed of as indicated below.

D. Storage of Materials

Storage of all salvageable materials, that will be reinstalled at a new location, shall be stored on-site or at such other locations as the Contractor may elect, subject to approval by the Engineer or designated representative. Security and maintenance of the salvageable materials shall be the responsibility of the Contractor.

E. Excess Materials

Materials, that are damaged, unsuitable for reinstallation or unnecessary for completion of the scope of the fence work in the new alignment shall be considered as excess but shall be offered to the Owner before removal from the site by the Contractor.

### 702.3 New Materials

New materials that are required to complete the fence at the location indicated on the Drawings shall be of equal quality to the existing materials. Used materials from other projects or from the Contractor's own used material stocks will not be allowed. The new materials to be furnished will be those necessary to replace items from the existing fence which were damaged during removal operations or which for other reasons cannot be reused.

### 702.4 Construction Methods

The removed fence shall be installed at the new assignment in accordance with the typical details indicated on the Drawings and shall comply with Standard Specification Item No. 701, “Fencing” and the best practice for fence construction of the specified type.

### 702.5 Measurement

Fences of the height and type to be relocated will be measured by the lineal foot (lineal meter: 1lineal foot equals 0.31 meters) of fence in its new location measured at the bottom of the fence along the centerline of the fence from center to center of terminal posts, excluding gates.

### 702.6 Payment

The work performed and material furnished as prescribed by this item measured under "Measurement" will be paid for at the unit bid price for "Removing and Relocating Fences" of the size and type specified to be relocated. The unit bid price shall include full compensation for removing, salvaging, storing and handling all existing fence materials; furnishing new posts, boards, rails, braces, tie wires, connection clips, fabric, rails, brace rods and any other fence component items that were damaged during removal and necessitating new material being furnished to complete the project; digging post holes and grouting in rock where required; furnishing concrete for post footings; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work including excavation, backfilling and disposal of surplus materials.

Gates as provided under "Measurement" will be paid for at the unit bid price for Removal and Relocation of Existing Pedestrian or Vehicular Gates of the type and size specified to be relocated. The unit bid price shall include full compensation for removing the gate from the existing locations, handling, storing and hauling all gate materials, furnishing any new materials necessary for installing at new locations; providing new center anchorage blocks, latches and catch blocks and for manipulations, labor, tools, equipment and incidentals necessary to complete the gate relocation.

Payment will be made under one of the following:

| | |
|---|---|
| Removing and Relocating Existing _Ft. Chain Link Fence | Per Lineal Foot. |
| Removing and Relocating Existing _Ft. x _Ft. Chain Link Pedestrian Gate | Per Each. |
| Removing and Relocating Existing _Ft. x _Ft. Chain Link Vehicular Gate | Per Each. |
| Removing and Relocating Existing _Ft. Wooden Fence | Per Lineal Foot. |
| Removing and Relocating Existing _Ft. x _Ft. Wooden Pedestrian Gate | Per Each. |
| Removing and Relocating Existing _Ft. x _Ft. Wooden Vehicular Gate | Per Each. |
| Removing and Relocating Existing _Ft. Wire Fence | Per Lineal Foot. |
| Removing & Relocating Existing __Ft. x _Ft. Metal Gate | Per Each. |

**End**

| ***SPECIFIC*** CROSS REFERENCE MATERIALS |
|---|
| Specification 702, “REMOVAL AND RELOCATION OF EXISTING FENCES” |

City of Round Rock Standard Specifications

| **Designation** | **Description** |
|---|---|
| Item No. 701 | Fencing |

| ***RELATED*** CROSS REFERENCE MATERIALS |
|---|
| Specification 702, “REMOVAL AND RELOCATION OF EXISTING FENCES” |

City of Round Rock Standard Specifications

| **Designation** | **Description** |
|---|---|
| Item No. 403 | Concrete for Structures |

Texas Department of Transportation: Standard Specifications For Construction of Highways, Streets and Bridges

| **Designation** | **Description** |
|---|---|
| Item No. 445 | Galvanizing |

| ***RELATED*** CROSS REFERENCE MATERIALS - continued |
|---|
| Specification 702, “REMOVAL AND RELOCATION OF EXISTING FENCES” |

American Society For Testing And Materials (ASTM)

| **Designation** | **Description** |
|---|---|
| A 53/A 53M | Specification For Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| A 116 | Specification For Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric |
| A 121 | Specification For Zinc-Coated (Galvanized) Steel Barbed Wire |
| A 153/A 153M | Specification For Zinc-Coated (Hot-Dip) on Iron and Steel Hardware |
| A 239 | Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron and Steel Articles |
| A 392 | Specification For Zinc-Coated Steel Chain-Link Fence Fabric |
| A 491 | Specification For Aluminum-Coated Steel Chain-Link Fence Fabric |
| A 585 | Specification For Aluminum-Coated Steel Barbed Wire |
| B 117 | Practice for Operating Salt Spray (Fog) Apparatus |

**ITEM NO. 703**
**FENCING FOR EXCAVATIONS**

### 703.1 Description

This item shall consist of temporary safety fencing supported on posts and constructed of materials as indicated and removed when excavation is backfilled.

### 703.2 Materials

(1) **Fabric**

(a) Fabric to be 4 feet in width, made of high density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence which will remain flexible from -60° F to 200° F, and be inert to most chemicals and acid. Pattern may vary from diamond to circular with a minimum weight per foot of 0.4 lbs./Ft., a 4 foot width minimum tensile yield strength (Horiz.) of 2000 psi, ultimate tensile strength of 2680 psi (Horiz.) and a maximum opening no greater than 2 inches.

(2) **Metal Posts**

Steel pipe, tee posts, U posts or 2" x 4 timber posts, 5½ feet in length minimum, spaced no more than 8 feet on centers. Fabric to be secured to post by bands or wire ties.

### 703.3 Construction Methods

Prior to commencing construction suitable “Barricades, signs and traffic handling” devices shall be installed to protect workers and public. Safety fencing shall be erected to lines and grades indicated. Excavations within 750 ft. of schools or day care centers require special attention by Contractor to secure entry while work is in progress. Fence shall be installed prior to excavation and maintained until excavation is backfilled. Fence shall be placed a minimum of 4 feet from edge of excavation. Posts shall be driven in ground a minimum of 18 inches. At completion of each day's work, safety fencing shall be pulled taut, and entry secured. When safety fence is no longer needed, Contractor shall remove fence and posts and patch any damage to surfaces.

### 703.4 Measurement

Safety fencing shall be measured by linear foot of fence measured along ground; gates will not be measured separately.

### 703.5 Payment

Work performed and materials furnished as prescribed by this item, measured as provided under "Measurement", shall be paid for at the unit price bid for "Safety Fencing" which price shall be full compensation for furnishing, installing and removing safety fencing and gates, including posts, bands or ties, and for manipulations, labor, tools, equipment and incidentals necessary to complete the work, removal and patching damaged surfaces.

Payment will be made under:

| | |
|---|---|
| Safety Fencing - | Per Linear Foot |

**End**

Ref. 803, 824

**ITEM NO. 704**
**METAL BEAM GUARD RAILING**

## 704.1 Description

This item shall consist of furnishing metal beam guard railing consisting of 1 line of metal beam rail element supported on timber or steel posts. Metal beam guard railing shall be constructed of materials and workmanship as indicated or as approved by the Engineer.

## 704.2 Materials

(1) **Rail Elements**

The rail elements, end shoes or terminal anchors shall be of the deep beam type fabricated to develop continuous beam strength and shall consist of a metal plate or sheet formed into a beam not less than 12 inches wide and 3 inches deep as indicated. The beam shall be free from warp. When tested with a straight edge or string along either edge of a 12½ foot sectional length of beam, the maximum deviation of the beam edges from the straight edge shall not exceed ½ inch at any point. The steel for the rail elements shall conform to AASHTO M-180. The rail shall be 12 gauge (0.1046 ±0.008 inch) or as indicated.

The rail element may be galvanized before or after fabrication in accordance with the requirements of ASTM A 123 or A 525, whichever is applicable, except that the galvanized coating shall not be less than 1.8 ounces per square foot of double exposed surface (single spot test).

Rail elements shall contain not more than 0.04 percent phosphorous nor more than 0.05 percent sulfur.

(2) **Posts**

The posts shall be either timber or steel as indicated and shall meet one of the following requirements:

Timber posts and spacers, where required, shall be Southern Yellow Pine. All posts shall be round. Posts shall not be less than 7 inches in diameter. The diameter shall be determined by means of a circumference-diameter tape. The average diameter at the base of the dome shall not exceed the specified diameter by more than 1 inch. The diameter at the butt of any post shall not exceed the diameter at the base of the dome of that post by more than 2 inches. The supplier shall stencil on the butt of each post the nominal diameter of the top 7 inches. The stenciled numeral shall be 1 inch high. The length of the posts shall not vary more than 1 inch from the specified length. They shall be of the length indicated; the bottom and the top shall be fabricated as indicated.

All posts shall be domed at the top. The dome shall be approximately hemispherical in shape and the radius of the dome of each post shall be ½ the diameter of the posts at the base of the domed portion. The dome shall be smooth and the distance from the top of the dome to the base of the dome shall not vary more than 1 inch at any location. The posts shall be machine peeled and

trimmed of all knots and knobs and shall be free from defects such as injurious ring shakes, unsound or loose knots or other defects which might impair their strength and durability. Sound knots will be permitted provided they are not in clusters and they do not exceed 1/3 of the smallest diameter or least dimension. Any defect or combination of defects which would be more injurious than the maximum allowable knot will not be permitted. A line drawn from the center of each end of the post shall not fall outside the center of the post at any point more than 1¼ inches at any point. Posts required, shall be bored and cut to dimensions indicated before being treated. They shall be treated with 0.4 pounds/cubic foot, dry pentachlorophenol treatment or ACA by assay. Posts and spacers, where required, shall be painted with two coats of good quality aluminum paint after the guard rail is erected unless otherwise indicated.

Steel posts and spacers, where required, shall be of the rolled sections as indicated. The posts and spacers, where required, shall be structural steel conforming to ASTM A 36. The top of all posts shall be beveled or square as required by detail and drilled or punched for bolts for rail attachments.

Steel posts and spacers, where required, shall be galvanized and shall conform to ASTM A 123.

Fittings shall consist of bolts, nuts and washers and shall conform to the details indicated and shall comply with the requirements as specified herein.

All bolts and nuts used with galvanized steel rail shall be made by either the open hearth or electric furnace process and shall conform to ASTM A 307. They shall be hot-dip galvanized to conform to ASTM A 153, Class C or D.

Unless otherwise indicated, the concrete for terminal anchor posts or for embedment or other posts in concrete, where required, shall meet the requirements for Class A Concrete, as specified in Item No. 403, "Concrete for Structures". The rail element for the terminal anchor section shall be of the same materials as the rail element used throughout the project.

**704.3 Sampling and Testing**

A sample of the rail and terminal section may be taken for each project or for each shipment to a project. Samples of bolts and nuts may also be required. All samples shall be furnished to the City free of charge. The plate or sheet shall be sampled and tested in accordance with the requirements of ASTM E-8. For galvanized articles, the weight of the zinc coating shall be determined by stripping in accordance with ASTM A 90.

The uniformity of the zinc coating shall be determined by visual inspection. If, in the opinion of the Engineer, visual examination is not conclusive, the uniformity of the coating may be determined by magnetic thickness gauge measurement in accordance with ASTM Designation: E 376 or by the Preece Test as described in ASTM Designation: A 239. When the Preece Test is used, all items designated in ASTM A 153 as Class B-2, B-3, C and D shall withstand a minimum of 4 one minute dips; all other items shall withstand a minimum of 6 one minute dips.

The cleaned area shall be coated with 2 coats of zinc dust compound meeting Federal Specification 0-G-98 (stick only), applied in accordance with the manufacturer's recommendations.

### 704.4 Construction Methods

The posts shall be set plumb and firm to the line and grade indicated. Unless the plans call for setting in concrete, the posts shall be backfilled by thoroughly tamping the material in 4 inch layers. The rail elements shall be erected to produce a smooth, continuous rail paralleling the line and grade of the roadway surface or as indicated. The rail elements shall be joined end to end by bolts and lapped in the direction of traffic in the lane adjoining the guard fence. When indicated, the rail elements shall be curved before erection. Holes for special details may be field drilled or punched, when approved by the Engineer.

After erection, all parts of galvanized steel posts, spacers where required, bolts and rail elements on which the galvanizing has become scratched, chipped or otherwise damaged shall be thoroughly cleaned by wire brushing the damaged area to remove all loose, cracked or bruised spelter coating. The cleaned area shall be painted with 2 coats of zinc dust-zinc oxide compound conforming to the requirements of Federal Specification TT-P-641b in accordance with the manufacturer's recommendations.

When fabrication is done after galvanizing and where indicated, the cut edges and bolt holes shall be cleaned by brushing and the cleaned area shall be painted with 2 coats of zinc dust-zinc oxide compound conforming to the requirements of the Federal Specification TT-P-641b or shall be repaired by application of galvanizing repair compounds in accordance with the manufacturer's recommendations.

No painting of galvanized steel rail members will be required.

### 704.5 Measurement

This item will be measured by the linear foot of rail, complete in place, measurement being made upon the face of the rail in place, from center to center of end posts, from terminal anchor sections or, in the case of structure railing connection, from the points indicated except as follows: Where bids are requested for "Terminal Anchor Sections", measurement will be made as each section, complete in place, each section consisting of a terminal anchor post and one 25 foot rail element, as indicated.

### 704.6 Payment

The work performed and material furnished as prescribed by this item, measured as provided under "Measurement" will be paid for at the unit price bid for "Metal Beam Guard Railing" or "Metal Beam Guard Railing, Terminal Anchor Sections", which price shall be full compensation for furnishing all materials, including necessary boring for preparation, hauling and erection and galvanizing of same; for setting posts in concrete when specified and spacers where required and for all labor, tools, equipment and incidentals necessary to complete the work, including driving posts, excavating, backfilling and disposing of surplus materials.

Payment will be made under one of the following:

Metal Beam Guard Railing - Per Linear Foot.

Metal Beam Guard Railing, Terminal Anchor Sections - Per Each.

**End**

**ITEM NO. 705**
**REMOVE AND RELOCATE EXISTING METAL BEAM GUARD RAILING**

### 705.1 Description

This item shall consist of removing and storing existing metal beam guard railing and posts and installing at the location indicated.

### 705.2 Materials

Materials will be those salvageable from the existing "Metal Beam Guard Railing" and any new materials required for the completion of the work as indicated. New materials shall meet the requirements of Item No. 704, "Metal Beam Guard Railing", unless those requirements are waived by the Engineer.

### 705.3 Construction Methods

The setting of posts and erection of the guard rail to be relocated as indicated shall be in accordance with the construction methods provided in Item No. 704, "Metal Beam Guard Railing". All salvageable material not needed for the relocated "Metal Beam Guard Railing" shall be stored on the project site as directed by the Engineer.

### 705.4 Measurement

This item will be measured by the linear foot of rail, complete in its new location, measurement being made upon the face of the rail in place, from center to center of end posts.

### 705.5 Payment

The work performed and new materials furnished as prescribed by this item, measured as provided under "Measurement" will be paid for at the unit price bid for "Remove and Relocate Existing Metal Beam Guard Railing", which price shall be full compensation for removing, salvaging, storing and handling all existing guard rail material, digging post holes, furnishing concrete for post footings, for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

All salvageable material not used in the relocated "Metal Beam Guard Railing" will remain the property of the City and shall be stored on the project site as directed by the Engineer.

Payment will be made under:

Remove and Relocate Existing Metal Beam Guard Railing - Per Linear Foot.

**End**

Ref: 704

**ITEM NO. 706**
**BRIDGE AND CULVERT RAILING**

### 706.1 Description

This item shall govern the construction of concrete, steel, or pipe railing or a combination of these materials on bridges, walls or incidental structures as indicated on the Drawings.

In general, the railing shall include that portion of the structure erected on and above the roadway curb or along the edges of walks, curbs and/or slabs for the protection of traffic and pedestrians and the tie in anchorage to the approach railing erected on the embankment.

The railing, including the necessary anchorage, shall be constructed in accordance with the details indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

### 706.2 Submittals

The submittal requirements of this specification item include:

A. Shop fabrication details/drawings for metal railings.

B. Splice locations and details.

C. Radiographic results for castings.

D. Mill test reports for each casting lot (chemical composition, tensile strength, elongation, etc.).

### 706.3 Materials

All materials shall conform to Class H, Item No. 403, "Concrete for Structures", Item No. 406, "Reinforcing Steel" and Item No. 720, "Metal for Structures" as appropriate.

### 706.4 Construction Methods

The railing shall meet the classification and type specified, conform with the requirements herein and be constructed in accordance with details indicated on the Drawings. It shall be constructed to the alignment, grade and camber indicated on the Drawings. Shop fabricated railing shall be uniform in configuration to insure good joints and continuous lines after erection on the structure.

Any appreciable amount of cutting, bending or filling required during erection to produce a reasonable fit would be cause for rejection of the rail. Unless otherwise provided, the railing shall not be placed until falsework, if any, for the span has been released. During construction, care shall be exercised to insure proper functioning of expansion joints.

Unless otherwise indicated on the Drawings, the rail posts shall be vertical. Fabrication and erection of metal for railing shall conform to Item No. 721, "Steel Structures" and to the requirements of this specification.

Splicing of members will be permitted only as provided by the contract Drawings . In general, splices shall be at rail posts. All splice locations and details shall be as indicated on the Drawings.

For metal railings, shop drawings shall be prepared and forwarded for review in accordance with Item No. 720, "Metal for Structures".

Welding shall conform to Item No. 723, "Structural Welding" and with applicable American Welding Society requirements.

Railing materials shall be stored above the ground on platforms, skids or other supports and kept free from grease, dirt and contact with dissimilar metals. Care shall be taken at all times to avoid scratching, marring, denting, discoloring or otherwise damaging the railing. Unpacking and storing of rail members at the job site shall be in accordance with manufacturer's recommendations.

A. **Concrete Railing**

For Portland cement concrete portions of railings, the construction and removal of forms and the placement, curing and surface finishing shall conform to Standard Specification Item No. 410, "Concrete Structures" and to the requirements specified herein. Provisions shall be made in the construction of forms to provide for checking and correction of railing lines and grades after concrete has been placed, but before initial set. The finish floating of the railing tops shall not disturb the form alignment after the final check. Particular care shall be exercised in other construction operations to avoid disturbing or vibrating the span with the newly placed railing.

Construction joints at the bottom of rail posts or rail parapet shall conform to Standard Specification Item No. 410, "Concrete Structures".

Precast members shall conform to TxDoT Specification Item 424, "Precast Concrete Structures (Fabrication). Care shall be taken to preserve true and even edges and corners of precast members. Any member, which becomes marred or cracked, will be rejected and shall be removed from the work.

Material requirements and storage, splicing, bending and placement of reinforcing steel for railing shall conform to the pertinent provisions of Standard Specification Item No. 406, "Reinforcing Steel".

B. **Pipe Railing**

Pipe shall be fabricated from the material and to the shape and dimensions indicated on the Drawings.

Pipe rail and posts shop fabricated into panels shall be mounted in a jig clamped in their true relative positions, accurately spaced with respect to each other and while assembled shall be completely welded or bolted, as the case may be. When indicated on the Drawings, as each rail section is completely assembled and connected, the adjacent section shall be set in its proper relative positions, with the ends engaged and remain in this position until completely connected. Each pair of sections shall be matchmarked so they may be erected in the same order in which they were fabricated.

C. **Metal Rail**

The fabricated elements shall conform to the dimensions and cross-section indicated on the Drawings. The rail shall be straight and free from warp.

Maximum deviation from straightness of either edge of a full-length section shall be ¼ inch per ten feet (6 millimeters per three meters).

Rail elements shall be jointed and connected to the rail posts as indicated on the Drawings. Lapped elements shall have the lap in the direction of traffic in the adjacent lane.

Unless indicated otherwise on the Drawings, bolts and nuts for the metal railing shall conform to ASTM A307 and shall be galvanized in accordance with TxDOT Specification Item 445, "Galvanizing".

D. **Cast Rail Posts**

Castings shall be true to pattern in form and dimensions and shall be of the materials indicated on the Drawings.

Castings shall be permanent mold castings of uniform quality and condition, free from cracks and shall be free of defects such as blow holes, porosity, hard spots or shrinkage effects which are extensive enough to materially affect their suitability for the intended use. The castings shall be free of all burrs, fins, discoloration and mold marks and shall, when finished, have a smooth and uniform appearance and texture.

Castings shall be produced under radiographic control to establish and verify a product free from harmful internal defects. Radiographic examination of production castings shall be made, as necessary, to insure satisfactory quality.

When required, the castings shall be heat treated to produce material with the utmost uniformity conforming to the properties specified. The entire lot of castings shall be heat- treated to the specified temper.

All castings shall be permanently marked on the web or top of base with the lot number or the heat treat lot identification. Mill test reports shall be furnished showing the heat or lot number, chemical composition, tensile strength, elongation and number of pieces for each casting heat or lot. Such markings shall be sufficient to correlate the castings with the mill test reports.

To provide more uniform materials and to reduce the number of samples required to establish material compliance, the entire number of acceptable posts cast from each lot shall be furnished to the project, except where less than the complete lot is required or where a portion of a lot is required to complete the shipment. The mill test report shall indicate the number of posts represented by each lot and furnished to the project.

**706.5 Tests**

For Metal Beam Rail, a sample of the rail and terminal may be taken from each project or from each shipment to a project. Samples of bolts and nuts may also be required. Physical tests shall be performed in accordance with TxDOT's Manual of Testing

procedures (ASTM E-8/E-8M) and tests for galvanized coatings shall be in accordance with ASTM A-90. Field testing of galvanized coating thickness shall be in accordance with TxDOT Test Method Tex-728-I.

### 706.6 Protective Coating

Unless otherwise indicated on the Drawings, all portions of steel railing shall be galvanized. When painting is specified on the Drawings, the type and coating thickness shall be in accordance with the paint system shown on the Drawings and shall conform with Standard Specification Item No. 722, "Paint and Painting".

Galvanized railing shall be hot dip galvanized after fabrication. Any damaged galvanizing shall be repaired after erection. Galvanizing and repairs shall be done in accordance with TxDOT Specification Item 445, "Galvanizing". Galvanized steel railing shall not require field painting. Prior to acceptance, extrusion marks, grease, dirt and grime shall be cleaned from the railing.

After erection, galvanizing on all parts of steel posts and rail elements which has become scratched, chipped or otherwise damaged shall be thoroughly cleaned, dry and free of oil, grease, welding slag or flux and corrosion products. The surface preparation shall be to near-white metal and shall extend into the undamaged galvanized coating to provide a smooth repair. Spray or brush apply the zinc-rich paint to the prepared area in accordance with the manufacturer's instructions to attain the required dry-film thickness.

After completion of the repair process, the coating thickness shall be measured in accordance with TxDOT Test Method Tex-728-I. The minimum coating thickness for repairs shall be the same as that required for the specified galvanizing.

Where fabrication is done after galvanizing and when indicated, the cut edges and bolt holes shall be cleaned by brushing and the cleaned area shall be painted with zinc-rich paint to the prepared area in accordance with the manufacturer's instructions to attain the required dry-film thickness.

### 706.7 Designation of Railing

Railing shall be designated by the general classification and type indicated on the Drawings.

### 706.8 Measurement

Railing of the classification and type designated will be measured by the lineal foot (lineal meter), complete in place, in accordance with the dimensions and details indicated on the Drawings.

### 706.9 Payment

The Work performed and materials furnished in accordance with this Specification Item and measured under Section 706.7, 'Measurement', will be paid for at the unit bid price for "Railing" of the classification and type indicated on the Drawings. The unit bid price shall include full compensation for: furnishing all materials including concrete, expansion joint material, reinforcing steel, structural steel, cast steel, pipe, anchor bolts, anchorage

devices for attaching Metal Beam Guard Fence, and all other materials required in the finished railing; all labor, tools, hardware, equipment, paint and painting, galvanizing; and all incidentals necessary to complete the work in the manner specified in this Specification Item and in accordance with the details specified in the contract Drawings.

For metal railing, the price paid shall be for the length of metal rail installed and shall not include concrete parapet walls or concrete wing terminal walls unless specifically designated on the Drawings.

Payment will be made under:

Bridge and Culvert Railing, Type _____ Per Lineal Foot.

**End**

| ***SPECIFIC*** CROSS REFERENCE MATERIALS |
|---|
| Specification 706, "BRIDGE AND CULVERT RAILING" |

City of Round Rock Standard Specifications

| Designation | Description |
|---|---|
| Item No. 403 | Concrete for Structures |
| Item No. 406 | Reinforcing Steel |
| Item No. 410 | Concrete Structures |
| Item No. 720 | Metal for Structures |
| Item No. 721 | Steel Structures |
| Item No. 722 | Paint and Painting |
| Item No. 723 | Structural Welding |

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

| Designation | Description |
|---|---|
| Item 445 | Galvanizing |
| Item 424, | Precast Concrete Structures (Fabrication) |

Texas Department of Transportation: Manual of Testing Procedures

| Designation | Description |
|---|---|
| Tex-728-I | Measurements of Dry Film Coating Thickness on Steel |

American Society for Testing and Materials

| Designation | Description |
|---|---|
| A-90 | Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles |
| A-307 | Specification for Carbon Steel Externally Threaded Standard Fasteners |
| E-8/E-8M | Methods of Tension Testing of Metallic Materials |

| ***RELATED*** CROSS REFERENCE MATERIALS |
| --- |
| Specification 706, “BRIDGE AND CULVERT RAILING” |

City of Round Rock Standard Specifications

| Designation | Description |
| --- | --- |
| Item No. 405 | Concrete Admixtures |
| Item No. 409 | Membrane Curing |
| Item No. 411 | Surface Finishes for Concrete |
| Item No. 558 | Structural Plate Structures |
| Item No. 559 | Concrete Box Culverts |
| Item No. 704 | Metal Beam Guard Railing |
| Item No. 705 | Remove and Relocate Existing Metal Beam Guard Railing |

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

| Designation | Description |
| --- | --- |
| Item 420 | Concrete Structures |
| Item 421 | Portland Cement Concrete |
| Item 427 | Surface Finishes for Concrete |
| Item 437 | Concrete Admixtures |
| Item 440 | Reinforcing Steel |
| Item 450 | Railing |

American Society for Testing and Materials

| Designation | Description |
| --- | --- |
| A-123 | Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| A-153 | Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Hardware |
| A-525 | Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process |

**ITEM NO. 710**
**BICYCLE RACKS**

## 710.1 Description

This item shall govern Class II and Class III bicycle racks and associated support medium as indicated on the Drawings.

A Class II bicycle rack shall be a rack where both wheels and the frame of a bicycle can be secured with one (1) user-supplied lock without the requirement for wheel removal. The design, type and capacity of a Class II bicycle rack shall be approved by the Engineer or designated representative

A Class III bicycle rack shall be a rack where both one wheel and the frame can be secured with a user supplied lock . The Class III rack shall consist of either a single U/Hoop (Rack 1), multiple inverted U/Hoop (Rack 2), single post (Rack 3), or other Rack approved by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

## 710.2 Submittals

The submittal requirements of this specification item include:

A. Class (i.e. II or III) Type and capacity (i.e. number of bicycles served).

B. Fabrication and installation details, color and finish of the rack(s).

C. Support medium (i.e. existing slab, new pad, concrete filled excavation, etc.) and details of installation.

D. Complete manufacturer's warranty against defects and workmanship for a period not less than one year from date of installation.

## 710.3 Materials

A. Steel elements

All steel shall be ASTM A-36 1010-1018 low carbon prime steel and the screws, nuts and bolts shall be tamper proof and plated with commercial zinc. The bicycle racks shall be hot dipped galvanized (ASTM A 123) unless the Drawings indicate that the rack assembly shall be provided in a specific color with a polyester-vinyl coated finish, a powder coated finish, or a polyvinyl thermoplastic finish.

B. Portland Cement Concrete

Portland cement concrete shall be Class A conforming to Specification Item No. 403, "Concrete for Structures".

C. Reinforcement

Reinforcement shall conform to Specification Item No. 406, "Reinforcing Steel".

D. Expansion Joint Materials

Expansion joint materials shall conform to Specification Item No. 408, "Expansion Joint Materials".

E. Membrane Curing Compound Membrane curing compound shall conform to Specification Item No. 409, "Membrane Curing".

**710.4 Construction of Racks**

A. Class II Bicycle Rack. The Class II Rack shall consist of a locking system, which will secure both bicycle wheels and the frame with one (1) lock without the removal of either wheel.

B. Class III Bicycle Rack.

1. The Class III Rack Type 1 shall consist of a one piece welded inverted U/Hoop assembly of Schedule 40 steel pipe with an minimum outside diameter (OD) of 1.5 inches (38 mm) on a minimum .25” (6.35 mm) thick base plate.

2. The Class III Rack Type 2 shall consist of a single Schedule 40 steel pipe with an minimum outside diameter (OD) of 2 3/8 (60 mm) set in Portland cement concrete below the ground surface as indicated on the Drawings. The steel pipe shall be topped with a 7 1/2 inch (190 mm) polymer molded sphere that is secured with a hardened steel pin.

3. The Class III Rack Type 3 shall consist of a one piece welded inverted U/Hoop assemble of Schedule 40 steel pipe with an minimum outside diameter (OD) of 2 3/8 inches (60 mm) supported with a minimum .25” (6.35 mm) thick circular base plate at one end of the rack and an in ground anchor mount on the other end.

4. The base plates can be round, square, or rectangular. If round, the diameter of the base plate must be at least 6” (150 mm) with a 4.5” (114 mm) bolt circle. If square, the base plate must be at least 4” by 4” (100 mm by 100 mm). If rectangular, the base plate must be 6” by 2” (150 mm by 50 mm). All base plates must be pre-drilled with two 3/8” (9.5 mm) diameter holes per plate for mounting. Each entire unit shall be hot dip galvanized after fabrication.

C. The bicycle racks shall be supported as indicated on the Drawings. The Class II racks and the Class III Rack Type 1 shall be supported on either existing or newly placed Portland cement concrete slabs. The Class III, Rack Types 2 and 3, can be placed on either existing or new slabs; however, these racks require additional underslab support of the steel pipe with p.c. concrete encasement.

The construction of the new slabs shall be completed in accordance with Standard Specification Item Number 432, “Concrete Sidewalks”. Unless noted otherwise on the Drawings, the slab shall be 4 inches (100 mm) in thickness.

**710.5 Measurement**

Bicycle Racks shall be measured per each, complete and in place and any new p.c. concrete slab will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) of surface area of "Concrete Bicycle Parking Pad".

**710.6 Payment**

The installation of Bicycle Racks, as described by this Specification Item, will be paid for at the unit bid price per each. The construction of a p.c. concrete bicycle-parking pad will be paid for at the unit bid price per square foot for "Concrete Bicycle Parking Pad".

The unit bid prices shall include full compensation for the specified equipment items; the location, placement and installation of parking racks; all materials, including all steel pipe and plates, screws, nuts and bolts, reinforcing steel and concrete; placing and finishing the concrete pad, and all labor, tools, and incidentals necessary to complete the work.

Payment will be made under one or more of the following:

| | |
|---|---|
| Class II Bicycle Rack | Per Each. |
| Class III, Type 1 Bicycle Rack | Per Each. |
| Class III, Type 2 Bicycle Rack | Per Each. |
| Class III, Type 3 Bicycle Rack | Per Each. |
| Class III, Other Type Bicycle Rack | Per Each. |
| 4 inch Concrete Bicycle Parking Pad | Per Square Foot. |

**End**

| ***SPECIFIC*** CROSS REFERENCE MATERIALS |
|---|
| Specification 710 “BICYCLE RACKS” |

City of Round Rock Standard Specifications

| Designation | Description |
|---|---|
| Item No. 403 | Concrete for Structures |
| Item No. 406 | Reinforcing Steel |
| Item No. 407 | Fibrous Concrete |
| Item No. 408 | Expansion Joint Materials |
| Item No. 409 | Membrane Curing |
| Item No. 410 | Concrete Structures |
| Item No. 432 | Concrete Sidewalks |

American Society for Testing and Materials (ASTM)

| Designation | Description |
|---|---|
| ASTM A 36 | Specification for Structural Steel |
| ASTM A 123 | Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products |

| ***RELATED*** CROSS REFERENCE MATERIALS |
| --- |
| Specification 710 “BICYCLE RACKS” |

**City of Round Rock Standard Specifications**

| Designation | Description |
| --- | --- |
| Item No. 102 | Clearing and Grubbing |
| Item No. 104 | Removing Concrete |
| Item No. 110 | Street Excavation |
| Item No. 111 | Excavation |
| Item No. 132 | Embankment |
| Item No. 201 | Subgrade Preparation |
| Item No. 405 | Concrete Admixtures |
| Item No. 406 | Reinforced Steel Tolerances |
| Item No. 411 | Surface Finishes for Concrete |
| Item No. 602 | Sodding for Erosion Control |
| Item No. 604 | Seeding for Erosion Control |
| Item No. 610 | Preservation of Trees and Other Vegetation |
| Item No. 642 | Silt Fence |

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

| Designation | Description |
| --- | --- |
| Item 420 | Concrete Structures |
| Item 421 | Portland Cement Concrete |
| Item 427 | Surface Finishes for Concrete |
| Item 437 | Concrete Admixtures |
| Item 440 | Reinforcing Steel |

American Society for Testing and Materials (ASTM)

| Designation | Description |
| --- | --- |
| A-496 | Standard Specification for Steel Wire, Deformed for Concrete Reinforcement |
| A-615/615M | Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |

**ITEM NO. 720**
**METAL FOR STRUCTURES**

### 720.1 Description

This item shall consist of all structural steels, high strength bolts, forgings, steel castings, iron castings, wrought iron, bronze, copper, steel pipe and tubing, aluminum castings and tubing and other miscellaneous metals used in structures except reinforcing steel and metal culvert pipe.

### 720.2 Process

All ferrous metals furnished for use under these specifications shall be made by one or more of the following processes only: open-hearth, basic oxygen or electric furnace.

### 720.3 Structural Steel

(1) **Steel for Main Members**

Unless otherwise indicated, structural steels listed herein shall conform to the longitudinal Charpy V-notch requirements of Group 1 in accordance with Table A. Sampling and testing shall be in accordance with ASTM A 673. The (H) frequency of heat testing shall be used for all material except that (P) frequency shall be used for ASTM A 514-517 steels.

(a) Carbon Steel

When indicated as Structural Steel-HYC, the material shall conform to ASTM A 36.

(b) High Strength Steel (HS)

High strength steel when indicated shall have a minimum required yield point of 50 ksi and will be indicated as Structural Steel-HS.

When so specified, the steel shall conform to one of the following ASTM Steels subject to thickness and physical requirements of the pertinent ASTM Specification:

1. ASTM A 572, High Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality, Grade 50. For welded structures the material will be limited to shapes in ASTM Groups 1, 2 and 3; plates and bars limited to a maximum thickness of 2 inches. For mechanically fastened structures, plates and bars will be limited to a maximum thickness of 4 inches.

**TABLE A**
**LONGITUDINAL CHARPY V-NOTCH REQUIREMENTS**

| Material | Thickness | Group 1 See Notes | Group 2 See Notes | Group 3 See Notes |
|---|---|---|---|---|
| A 36, A 440 and A 242 | Up to 4 inches | 15 ft. lb at 70° F | 15 ft. lb at 40° F | 15 ft. lb at 10° F |
| | Up to 4 inches mechanically fastened | 15 ft. lb. at 70° F | 15 ft. lb. 40° F | 15 ft. lb. at 10° F |
| A 572* | Up to 2 inches welded | 15 ft. lb at 70° F | 15 ft. lb 40° F | 15 ft. lb at 10° F |
| | Up to 4 inches mechanically fastened | 15 ft. lb at 70° F | 15 ft. lb at 40° F | 15 ft. lb at 10° F |
| A 588* | Over 2 inches to 4 inches welded | 20 ft. lb at 70° F | 20 ft. lb at 40° F | 20 ft. lb at 10° F |
| | Up to 4 inches mechanically fastened | 25 ft. lb at 30° F | 25 ft. lb at 0° F | 25 ft. lb at -30° F |
| A 514-517 | Up to 2 ½ inches welded | 25 ft. lb. at 30° F | 25 ft. lb. at 0° F | 25 ft. lb. at -30° F |
| | Over 2 ½ inches to 4 inches welded | 35 ft. lb. at 30° F | 35 ft. lb. at 0° F | 35 ft. lb. at -30° F |

Notes:
Group 1: Minimum Service Temperature 0 F and above.
Group 2: Minimum Service Temperature from -1 F to -30 F.
Group 3: Minimum Service Temperature from -31 F to -60 F.

*If the yield point of the material exceeds 65 ksi, the temperature for the CVN value for acceptability shall be reduced by 15 F for each increment of 10 ksi above 65 ksi.

2. ASTM A 588, High-Strength Low-Alloy Structural Steel With 50,000 psi Minimum Yield Point to 4 Inch Thickness.

(c) Extra High Strength Steel (XHS)

Extra high strength steel when indicated shall have a minimum required yield point of 90 ksi and will be designated on the plans and in the bid as Structural Steel-XHS. When so specified, the steel shall conform to the following:

1. ASTM A 514, High-Yield Strength, Quenched and Tempered Alloy Steel Plate.

The steel furnished shall be suitable for welding. Structural shapes and seamless tubing, meeting the other requirements of A 514 steels, will be permitted with a maximum tensile strength of 140 ksi for structural shapes and 145 ksi for seamless tubing.

2. ASTM A 517, Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered.

The above listed steels are considered weldable. Other steels will require qualification in accordance with TXDOT Bulletin C-5 prior to their use.

(2) **Miscellaneous Steel**

(a) Unless otherwise indicated, structural steel for members such as shoes, diaphragms, stiffeners (including bearing stiffeners), lateral bracing, diagonals, armor joints and finger joints shall conform to ASTM A 36 or A 500, Grade B.

Structural steels used for secondary or nonstress-carrying members will not be subject to impact requirements.

All steels greater than ½ inch in thickness used for structural supports for highway signs, luminaries and traffic signals shall conform to the longitudinal Charpy V-notch requirements of Group 1 in accordance with Table A.

(b) Stud shear connectors, slab anchors and anchors on armor joints and finger joints shall conform to ASTM A 108, cold drawn bars, Grades 1015, 1018 or 1020, either semi- or fully-killed.

Tensile properties as determined by tests or bar stock after drawing or finishing shall conform to the following:

| | |
|---|---|
| Tensile Strength (Minimum) | 60,000 psi |
| Yield Strength (Minimum) | 50,000 psi |
| Elongation (Minimum) | 20% in 2 inches |
| Reduction of Area (Minimum) | 50% |

Tensile properties shall conform to ASTM A 370.

The manufacturer shall certify that the studs or anchors as delivered conform with the material requirements of this section.

(c) High strength bolts shall conform to ASTM A 325 or A 490, unless otherwise indicated.

A mill test report or certification will be required indicating that the bolts conform to these requirements.

(d) Steel piling shall conform to the following:

| Type | ASTM Designation |
|---|---|
| Steel H Piling | A 36 |
| Metal Shell Piling (heavier than 10 gauge) | A 252* Grade 2 or A 36 |
| Sheet Piling (Rolled) | A 328* Grade A |
| Sheet Piling (Formed) | A 570* Grade A |

*A mill certificate shall be furnished by the manufacturer certifying to the results of test required by the governing specifications.

Sheet piling of a different configuration than that indicated may be used provided the section modulus and weight per foot furnished is equal to or greater than indicated.

(e) Deck Plates

Material for deck plates shall conform to one of the following:

Corrosive resistant structural steel conforming to ASTM A 242 or A 440. The material must be of weldable quality and shall contain alloying elements that furnish corrosion resistance at least twice that of copper bearing structural steel. The type of material to be used and the trade name, shall be stated on the shop plans.

(f) Rail Posts

Material for rail posts shall conform to ASTM A 36, unless otherwise indicated.

### 720.4 Steel Forgings

Steel forgings from which pins, rollers, trunnions or other forged parts are to be fabricated, shall conform to the requirements of the Standard Specifications for Carbon-Steel Forgings for General Industrial Use, ASTM A 668, Class C, D, F or G. The above will govern material for rail posts and shall conform to ASTM A 36, unless otherwise indicated for all Railroad underpass structures. The class of material shall be as indicated.

For other structures, for pins 4 inches in diameter or less, material conforming to ASTM A 108, Grades 1016 to 1030 may be used. The material shall have a minimum yield point of 36 ksi. All forgings shall be thoroughly annealed prior to being machined to form finished parts. Material for pins over 4 inches in diameter shall be in accordance with ASTM A 668, Class C, D, F or G. The class of material shall be as indicated.

### 720.5 Steel Castings

Steel castings shall conform to the specifications for Mild to Medium Strength Carbon Steel Castings for General Application, ASTM A 27, Grade 70-36.

When indicated as Class 70, Class 90 or Class 120, the steel castings shall conform to the specified class of ASTM A 486.

### 720.6 Iron Castings

All iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

The castings specified shall conform to the following ASTM Designations:

| Material | ASTM Designation | Grade |
|---|---|---|
| Gray-Iron Castings | A 48 | Class 30 |
| Malleable Castings | A 47 | 35018 |
| Ductile Iron Castings | A 536 | 60-40-18 |

### 720.7 Lead

Sheet lead shall conform to the requirements of the Specifications for Pig Lead, ASTM Designation: B 29.

### 720.8 Copper Strip or Sheet

Copper strip or sheet copper shall be cold-finished and annealed, soft or 1/8 hard temper meeting the requirements of AASHTO M 138. The sheet shall stand being bent cold through an angle of 180 degrees flat upon itself without fracture on the outside of the bent portion.

### 720.9 Anchor Bolts

Unless otherwise indicated, plain and threaded bars used for anchorage purposes shall conform to ASTM A 36. Headed bolts and nuts shall conform to ASTM A 307, Grade A. When high strength anchor bolts are indicated, they shall conform to ASTM A 193-B-7 as indicated. Nuts for high strength anchor bolts shall conform to ASTM A 194-2H.

Threads for anchor bolts and nuts shall be UNC Series, Class 2 fit for 1 inch diameter and smaller. Threads for anchor bolts and nuts over 1 inch diameter shall be 8UN Series, Class 2 fit.

All anchor bolts and nuts, when galvanized, shall be tapped or chased after galvanizing.

Anchor bolts shall not be galvanized unless otherwise indicated.

A mill test report or certification will be required indicating that the material conforms to these requirements. When heat treated material is specified or required, the test report for certification shall include the necessary certification relative to the heat treating process.

### 720.10 Steel Pipe

Steel pipe shall conform to Item No. 510, "Pipe".

### 720.11 Steel Tubing

Steel tubing shall conform to ASTM A 500, Grade B, unless otherwise indicated. Tubing conforming to API Standard 5LX, Grade 52, except as noted herein, may be used if produced by a mill recognized as "authorized to produce pipe with the API mono-gram"

and listed as such in the standard API specifications.

The following exceptions to the requirements of API 5LX, Grade 52, will be allowed:

Hydrostatic tests will not be required.

In lieu of the mill test report, a certificate from the manufacturer will be required for each lot or shipment certifying that the tubing meets the requirements stated above.

### 720.12 Pipe Rail

Pipe shall be construed to include special extruded and bent shapes and shall be of the section indicated. Pipe may be rolled or extruded to the shape indicated or may be cold pressed from a round pipe or flat plate.

If cold pressed, the design of the press and dies shall result in a pipe of uniform section and free from die marks. After the pipe has been formed to the required section, it shall be cut to the lengths required. The end cuts and notches shall be made at such angles with the axis of the pipe as required to produce vertical end faces and plumb posts when indicated. Cutting and notching of pipe shall be done with a saw or machine guided torch or other means that will insure a neat and workmanlike finish.

### 720.13 Steel Deep Beam Rail

The rail element shall be either 10 gage (0.1345 ± 0.008 inch nominal thickness) or 12 gage (0.1046 ± 0.008 inch nominal thickness), exclusive of protective coating, as indicated. Rail element shall meet all requirements of AASHTO M 180 except as indicated.

The terminal connector shall be of the same material, but shall not be less than 10 gage.

Unless otherwise indicated, the rail element shall be galvanized.

### 720.14 Aluminum

(1) Unless otherwise indicated, aluminum materials shall conform to the following:

| | |
|---|---|
| Castings | ASTM B 108, Alloy A444-T4 |
| Extrusion | ASTM B 221, Alloy 6061-T6 |
| Sheet & Plate | ASTM B 209, Alloy 2024-T3 |

Test specimen from castings shall be cut, either vertically or horizontally, from the lower 14 inches of the tension flange but not at the junction of the rib or base. The curved surfaces shall be flattened prior to machining. Test specimens shall conform to ASTM Designation: E 8, Figure 8.

(2) Aluminum Deep Beam Rail

| Material | ASTM Designation | Alloy |
|---|---|---|
| Beam Section | B 209 | 2024-T3 |
| Terminal Section | B 209 | 2024-T3 |

The minimum thickness of the rail element shall be 0.156 inch (nominal) or 0.105 inch (nominal) as indicated.

### 720.15 Fabrication, Erection and Painting

Fabrication, welding and erection of structural metal shall conform to Item No. 721, "Steel Structures", Item No. 723, "Structural Welding" and TXDOT Bulletin C-5. Paint and painting shall conform to Item No. 722, "Paint and Painting". Aluminum or galvanized steel members shall not require painting.

### 720.16 Galvanizing

Galvanizing of metal fabricated from rolled, pressed or forged steel shapes, plates, pipe and bars, shall conform to ASTM A 123. Galvanizing of steel or iron castings shall conform to ASTM A 153, Class A. Galvanizing of bolts, nuts, screws, washers and other miscellaneous hardware, shall conform to ASTM A 153, Class C or D or B-454, Class 40. The weight of galvanized coating shall be determined according to TXDOT Test Method Tex-728-I.

Galvanizing will not be required for any material unless indicated.

### 720.17 Measurement

Measurement of the quantity of structural metal furnished and placed will be based on the weight of metal in the fabricated structure. The weight of erection bolts, paint or weld metal shall be excluded.

When increases in size or weights of members have been made which were not ordered but approved by the Engineer, the measurement will be made on the sizes or weights indicated.

In determining the weight of structural metal in steel or concrete structures, such items as castings, bearing plates, anchor bolts, drains, deck plates, armor joints, finger joints and all other metal for which no separate measurement is specified, will be considered as Structural Steel.

The weights of rolled shapes and plates shall be computed on the basis of their normal weights and dimensions using English measurements as indicated. The weight of castings will be computed from the dimensions indicated. Shoes will be measured by the weights indicated or as specified for castings, if weights are not shown.

Deductions will be made for all cuts, copes, perforations and all holes except bolt holes.

When computed, the weight of metal will be based on Table I.

Splices will be measured as follows:

No additional weight will be allowed for weld metal in a welded splice.

Where a bolted splice is permitted as an alternate for a welded splice, measurement will be made on the basis of a welded splice.

Where a bolted splice is required, the weight of splice material, bolt heads, washers and nuts, with no deduction for holes, will be measured.

A change in design concept which either increases or reduces the quantity of metal going into the structure or structures, will be measured by actual computed weights of the metal and the quantity as indicated, will be increased or decreased by the revised weights, as the case may be.

| **Pay Weights - Lbs. per Cu. In.** | | | | | |
|---|---|---|---|---|---|
| **Material** | Steel | Cast Iron | Wrought Iron | Bronze | Lead |
| Weight | 0.2833 | 0.2604 | 0.2777 | 0.3150 | 0.4085 |

| **High Strength Bolts - Weight per Hundred Units** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Diameter (Inch)** | ½ | 5/8 | ¾ | 7/8 | 1 | 1 1/8 | 1¼ |
| Bolt Heads | | | 15 | 25 | 36 | 52 | 73 |
| Nuts | | | 19 | 28 | 41 | 56 | 73 |
| Washers | | | 12 | 12 | 18 | 21 | 27 |

**720.18 Payment**

Structural metal will be paid for at the unit price bid per pound for "Structural Steel, HYC", "Structural Steel, HS" or for such other classifications of metal as indicated.

Shipping invoice or acceptance slip weights will not be used as basis for payment.

The quantity to be paid for will be that quantity indicated, except as may be modified by the following:

(1) Either party to the contract may request an adjustment of the quantities indicated (by each separate bid item), if the weights, calculated above, vary from those indicated by more than the following:

(a) Over 500 tons - ½ of 1 percent.
(b) 50 tons through 500 tons - 1 percent.
(c) Less than 50 tons - 1½ percent.

When adjustment is required, the Contractor shall furnish the Engineer three sets of shop bills showing the calculated weights of all parts of the structure. The weights shall be computed from the approved shop drawings, except as noted

above. When this quantity is certified correct by the Engineer, it will become the revised plan quantity. Quantities revised in this manner will not be subject to the provisions contained elsewhere in the Contract.

(2) When quantities are revised by a change in design the "plan quantity" will be increased or decreased by the amount involved in the design change. Quantities revised in this manner will be subject to the provisions of the continued elsewhere in the Contract.

This price shall be full compensation for furnishing all materials and for all fabrication, shopwork, transportation, erection, paint, painting, galvanizing and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

Structural Steel, HYC - Per Pound.

Structural Steel, HS - Per Pound.

End

Ref: 510, 721, 722, 723

**ITEM NO. 721**
**STEEL STRUCTURES**

## 721.1 Description

This item shall consist of the fabrication and erection of structural steel and other metal used for steel structures or steel portions of structures, except reinforcing and prestressing steel as indicated.

## 721.2 Materials

The metal used for the various portions of the structures shall conform to Item No. 720, "Metal for Structures" and to details indicated.

## 721.3 General

(1) **Shop Drawings**

The Contractor shall prepare and submit detailed shop drawings for each detail of the general plans requiring the use of Structural Steel, Forgings, Wrought Iron, Castings or Bearings. Camber and erection diagrams will be required for all structures and bridges. The drawings shall be prepared on sheets 24 by 36 inches. The margin at the left end shall be 1½ inches wide and the others ½ inch. Each sheet shall have a title in the lower right-hand corner of the project plans, sheet numbering for the shop rawings, name of structure or stream, name of Fabricator and name of Contractor.

Preparation and submission of drawings may be on 11 x 17 inch sheets or full size drawings may be reduced to half scale size if they are completely clear and legible.

All shop drawings shall be checked by the Fabricator before submitting them to the Engineer.

Six copies of shop drawings and 7 copies of erection drawings will be required.

Contractor shall be responsible for the correctness and completeness of the drawings and for shop fit and field connections, although the drawings have been passed on by the Engineer.

Details of joints to be used with manual welding shall be as indicated. When the use of submerged arc welding, gas metal-arc welding or flux cored arc welding processes are anticipated, the shop drawings shall reflect the correct joint details.

For plate girder units, preliminary erection drawings showing the sequence of erection, the location of falsework and the location of ground and air splices with the proposed method of support to determine any overstress caused by the erection procedure shall be submitted to the Engineer for review prior to the submission of shop drawings. Five copies will be required.

When painting is indicated, it shall conform to Item No. 722, "Paint and Painting".

When structural members are to be fabricated by welding, a welding procedure shall be submitted in accordance with SDHPT Bulletin C-5. A minimum of 5

copies of each required procedure shall be submitted. Upon approval, the welding procedure will be assigned a Welding Procedure Number. The Shop Drawings shall include this number adjacent to the appropriate welding symbol.

When structural members with calculated stress are fabricated by welding or bolting, a fabrication procedure will be required. A fabrication procedure shall include a list of equipment to be used, sequence of assembly, sequence and detail of connections made, special processes such as planing, facing, etc., detail of heat treating procedures, when applicable and any other information concerning fabrication, as may be required by the Engineer.

(2) **Notice of Beginning Work**

The Contractor shall give the Engineer 7 days notice prior to the beginning of work in the shop.

No work shall be performed in the shop before the Engineer has authorized fabrication. Any purchases of material prior to fabrication authorization shall be at the Contractor's risk.

(3) **Inspection and Testing**

The Contractor shall provide facilities for the inspection of material and workmanship in the shop and furnish the Inspector with as many helpers as he needs to properly inspect the work. The Inspector shall be allowed free access to the necessary parts of the work.

The Inspector will have the authority to reject any material or work which does not meet the requirement of these specifications. In case of dispute, the Contractor may appeal to the Engineer, whose decision will be final.

Prior to beginning fabrication, the Fabricator shall furnish the Engineer with 4 copies of the completed material identification form with supporting mill test reports including:

Specification to which material is produced.

Heat number of material.

Chemical and physical properties of the material required by the material specification.

Impact test data when required.

Grain size or statement that fine grain practice was used, when required.

Mill test reports will not be required for miscellaneous hardware.

As miscellaneous materials are shipped, the Fabricator shall furnish the Engineer with 4 copies of his shipping invoice. The Fabricator's shipping invoice shall reflect:

Member piece mark identification.

Number of pieces shipped.

Total calculated or scale weight for each shipment per bid item.

Final payment for structural steel will not be made until shipping invoices indicating total weight of material used have been received and checked by the Engineer. Shipping weights will not be used as measurement for payment. The acceptance of any material or finished members by the Inspector will not prohibit subsequent rejection if found defective. Rejected material shall be replaced promptly or made good by the Contractor.

(4) **Workmanship**

For railroad underpass structures, shop workmanship shall be in accordance with the latest American Railway Engineering Association Specification for Steel Railway Bridges for Fixed Spans.

All structural materials, before and after fabrication, shall be stored above the ground upon platforms, skids, blocking or other supports approved by the Engineer. The material shall be kept free from dirt, grease and other foreign matter and shall be protected as nearly as practicable from corrosion.

Fabrication and rolling tolerances for rolled shapes, plates, bars, wide flange sections and miscellaneous steel shall be in accordance with ASTM A 6. Tolerances for fabricated girders shall be in accordance with SDHPT Bulletin C-5.

Rolled sections or fabricated sections of slightly different dimensions and weight than the standard sections shown will be acceptable, provided equal or greater Moment of Inertia and Section Modulus for the completed section are provided.

Maximum deviation from flatness for webs of wide flange sections shall be the same as for built-up girders.

Shoes shall be fabricated with a tolerance not greater than the following:

The top bolster shall have the center 75 percent of the long dimension true to 1/32 inch, with the remainder true to 1/16 inch and shall be true to 1/32 inch across its entire width in the short dimension.

For a pin and rocker type expansion shoe, the axis of rotation shall coincide with the central axis of the pin.

When the shoe is completely assembled and the top bolster is moved horizontally simulating the movement of the shoe in the finished structure, no point in the plane of the top bolster shall change elevation by more than 1/16 inch for the full possible travel of the rocker both ways from the neutral position nor shall the top bolster change inclination with respect to the horizontal by more than 1 degree during this same travel.

I-beams and girders shall be fabricated with a tolerance not greater than the following:

The plane of the bearing area of beams and girders shall be perpendicular to the vertical axis of the beam within 1/16 inch.

Correction of bearing areas of shoes, beams and girders to the above tolerances shall be with heat and/or external pressure. Grinding or milling

will be permitted if reduction of required thickness of member is not reduced by more than 1/16 inch.

Rolled material must be straight before being laid off or worked.

If straightening is necessary, it shall be done by procedures submitted to and approved by the Engineer. Sharp kinks and bends will be cause for rejection of the material unless corrected to the satisfaction of the Engineer or designate representative.

The handling of material, fabrication, blocking of partially completed members and movement of completed members shall be done in such a manner that the safety of workmen and inspection personnel will not be impaired at any time.

All weathering structural steel and other designated steels requiring weathering characteristics shall be maintained at all levels of fabrication and construction as nearly as possible in the condition received from the mill. All shop welds shall be cleaned by power grinding or by blast cleaning to remove welding flux, slag and splatter prior to shipment from the plant.

After all erection, welding and slab concrete placement has been completed, the Contractor shall restore the surfaces of all weathering structural steel as nearly as possible to the above described condition by solvent cleaning, hand cleaning, power brush cleaning or brush-off-blast cleaning, as deemed necessary by the Engineer or designated representative, to restore the steel to its original clean condition.

All outside surfaces of weathering steel fascia beams, including the underside of the bottom flange, the sides and bottom surfaces of steel bent caps or floor beams and all surfaces of outrigger-type bent caps extending outside the fascia beams shall receive a Class B blast cleaning in addition to the above requirements. No marking will be permitted on the outside face of any fascia beam.

## 721.4 Bolted and Welded Structures

(1) Cutting, Planing, Facing and Fit of Members

Sheared edges of plates of more than 5/8 inch thickness and carrying calculated stress shall be planed to a depth of ¼ inch. Re-entrant cuts shall be filleted to a minimum radius of ¾ inch, except for the corners of welding access cope holes adjacent to a flange. The fillet and its contiguous cuts shall meet without offset or cutting past the point of tangency (no gouges, etc.)

Unless otherwise indicated, steel plates for main members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses.

Steel and weld metal may be oxygen cut, provided a true profile and a smooth and regular surface free from cracks and notches is secured by the use of a mechanical guide. Hand cutting shall be done only where approved by the Engineer. Mill scale and extraneous material shall be removed from the cutting side of ASTM A 514/A 517 steel plates along the lines to be cut.

Edges of all main members which are sheared or oxygen cut and all other exposed edges to be painted shall be rounded or chamfered to an approximate 1/16 inch dimension by grinding.

In all oxygen cutting, the flame shall be adjusted and manipulated to avoid cutting inside the prescribed lines. Roughness of the cut surfaces shall not be greater than ANSI surface roughness value of 1000 for material up to 4 inches thick and 1600 for material 4 inches to 8 inches thick, except that member ends not subject to calculated stress shall meet ANSI surface roughness value of 2000. Roughness exceeding these values and occasional notches or gouges not more than 3/16 inch deep on otherwise satisfactory surfaces shall be removed by machining or grinding. Cut edges shall be left free of slag. Correction of defects shall be flared to the oxygen cut edges with a slope not exceeding 1 in 10.

Air carbon-arc or oxygen gouging, oxygen cutting, chipping or grinding may be used for joint preparation or the removal of defective work or material. Oxygen gouging shall not be used on A 514/A 517 or A 588 weathering steel.

Oxygen cut edges of ASTM A 440 steel ½ inch or greater in thickness shall be removed to a depth of at least 1/8 inch by machining or grinding, except that machine flame cut edges need cut edge uniformly and progressively to a red heat to a depth of at least 1/16 inch from the edge (1150 F to 1250 F) or post heated by a torch attached to and following the cutting torch with the tips, gas pressure, speed of travel and the distance of the post heating torch from the cutting torch regulated to the thickness of the steel to accomplish the annealing effect described above.

The top and bottom surfaces of steel slabs, base plates and cap plates of columns and pedestals shall be planed or else the steel slabs and base plates hot-straightened. Parts of members in contact with plates shall be faced to fit. For plates over 4 inches thick, top surfaces shall be planed to an ANSI surface roughness value of 250.

Surfaces of bearing plates intended for sliding contact shall have an ANSI surface roughness value of 125.

In planing the surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.

When stiffeners are required by the plans to be milled, the milled surfaces shall meet ANSI surface roughness value of 500 and shall provide an even bearing against the flange. Tight-fit, when indicated, shall have at least 1 point bearing on the flange surface and the remainder with a maximum clearance of 1/16 inch at any point. Where stiffeners are to be welded to the flange, the opening prior to shall not exceed 3/16 inch with the fillet weld size increased by the amount of the opening.

Unwelded, cold-bent, load-carrying, rolled-steel plates shall conform to the following:

(a) The bend line shall be at right angles to the direction of rolling.
(b) Bending shall be done so that no cracking of the plate occurs. Minimum bend radii, measured in the concave face of the metal, are shown in Table 1.

**Table 1**
**Bend Radii for all Grades of Structural Steel**

| **Thickness (t) in inches** | Up to ½ | Over ½ to 1 | Over 1 to 1 ½ | Over 1 ½ to 2 ½ | Over 2 ½ to 4 |
|---|---|---|---|---|---|
| Minimum Bend Radii | 2t | 2 ½ t | 3t | 3 ½ t | 4t |

(c) Before bending, the corners of the plate shall be rounded to a radius of 1/16 inch throughout the portion of the plate to be bent.

Finished machining, boring and straightening shall be subsequent to annealing or normalizing structural members. Normalizing and annealing (full annealing) shall be as defined in ASTM E 44. The temperatures shall be maintained uniformly throughout the furnace during the heating and cooling so that the temperature at any points on the member will not differ by more than 100° F.

A 514 and/or A 517 steel shall not be annealed or normalized and shall be stress relieved only with the approval of the Engineer.

High strength steel over ½ inch thick may require hot bending for small radii. For short radius on High Strength (HS) or High Yield Carbon (HYC) steels, the plates shall be hot bent at a temperature not greater than 1200° F.

Allowance for springback of A 514/A 517 steel should be about 3 times that for carbon steel. For break press forming, the lower die span should be at least 16 times the plate thickness. Multiple hits are advisable. If A 514/A 517 steel plates to be bent are heated to a temperature greater than 1125° F, they must be requenched and tempered in accordance with the producing mill's practice.

Hot bent plates shall conform to the requirements of (1) above.

The holding temperature for stress relieving A 514 and/or A 517 steel shall not exceed 1100° F, except that 950° F shall be maximum for welds and 6 inches surrounding welds.

When indicated, bridge shoes, pedestals or other parts which are built up by welding sections of plate together shall be stress relieved in accordance with approved procedures.

(2) **Repair of Defects**

(a) Correction of Defects on Edges to be Welded

1. Correction of cutting defects and of occasional notches or gouges less than 7/16 inch deep for material up to 4 inches thick and less than 5/8 inch for material over 4 inches thick may be made on steel with yield strengths up through 65,000 psi by welding.

   Discontinuities or nonmetallic stringers, opening in plate edges which form the faces of groove welds which will subsequently be fused with the weld, shall be removed to a depth of 5/8 inch and repaired by welding. Laminations opening to these edges shall be removed. Weld repairs shall be made after suitably preparing the defect, welding with low hydrogen electrodes not exceeding 5/32 inch in diameter, conforming to SDHPT Bulletin C-5 and grinding the completed weld smooth and flush with the adjacent surfaces.

(b) Occasional notches, gouges or defects in oxygen cut edges of A 514/A 517 steel may be repaired by welding, when approved by the Engineer under the following conditions:

Cutting defects not more than 3/16 inch deep in plate edges which will form the faces of a groove weld joint and which will subsequently be completely fused with the weld may be repaired by welding. Discontinuities or nonmetallic stringers opening to these edges shall be removed to a depth of ¼ inch below the surface by grinding or chipping and the gouge repaired by welding. Laminations opening to these edges shall be removed.

Cutting defects not more than 3/16 inch deep in plate edges which will form a fillet-welded corner joint shall be repaired by welding only on the part of the edge which will become the faying surface for the joint and the fusion zone of the fillet weld. The part of the defect outside the toe of the completed fillet weld shall be removed by machining or grinding and faired to the oxygen cut surface with a slope not exceeding 1 in 10. If the actual net cross-sectional area which would remain after removal of the discontinuity is 98 percent or greater than the area of the plate based on nominal dimensions, weld repairs shall be made as specified above using E-11018-M electrodes and grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

(3) Correction of Defects in Free Running Edges of All Steel

(a) Roughness exceeding ANSI surface roughness value of 2000 in oxygen cut surfaces and occasional notches or gouges not more than 3/16 inch deep on otherwise satisfactory surfaces, shall be removed by machining or grinding to a slope not exceeding 1 in 10.

(b) In the repair and determination of limits of internal discontinuities visually observed on rolled, sheared or oxygen cut edges and caused by entrapped slag or refractory, deoxidation products, gas pocket or blow holes, the metal removed shall be the minimum necessary to remove the defect or to determine that the permissible limit is not exceeded. All repairs made by welding shall be approved by the Engineer and shall conform to the applicable provisions of SDHPT Bulletin C-5.

The limits of acceptability and the repair of visually observed edge discontinuities in plates 4 inches or less in thickness shall be in accordance with Table 2 where the length of defect is the visible long dimension on the plate edge and the depth, the distance the defect extends into the plate from the edge.

**Table 2**
**Repair of Discontinuities**
**Visible Edge Imperfections for Plate Thickness of 4 Inches and Under**

| Description of Discontinuity | Repair Required |
|---|---|
| Any discontinuity 1 inch in length or less | None - need not be explored. |
| Any discontinuity over 1 inch in length and 1/8 inch maximum depth. | None - depth should be explored. |
| Any discontinuity over 1 inch in length with depth over 1/8 inch but not greater than ¼ inch. | Remove - need not weld. |
| Any discontinuity over 1 inch in length with depth over ¼ inch but not greater than 1 inch. | Completely remove and weld. Aggregate length of welding not over 20 percent of plate edge length being repaired. |
| Any discontinuity over 1 inch in length with depth greater than 1 inch | Subject to approval by the Engineer. Gouge out to 1 inch and block off by welding. Aggregate length of welding not over 20 percent of plate edge length being repaired unless approved by the Engineer. |

Removal of metal by gouging shall be done in a manner assuring adequate width and slope for welding.

Multiple discontinuities should be considered continuous when located in the same plane within 5 percent of the plate thickness and separated by a distance less than the length of the smaller of two adjacent continuities.

(4) **Repair of Surface Defects**

The limits of acceptability and repair of surface imperfections for all steels shall be in accordance with ASTM A 6.

(5) **Heat Curving**

Structural steel with a specified minimum yield point not greater than 50,000 psi may be heat curved. For heat-curved beams and girders, the horizontal radius of curvature measured to the centerline of the web shall not be less than 150 feet and shall not be less than the larger of the values calculated (at any and all cross sections throughout the length of the girder or beam) from the following two equations:

$$R = \frac{14\ b\ D}{(vFy)(x)(t)}$$

$$R = \frac{7500\ b}{FyX}$$

In these equations, Fy is the specified minimum yield point in ksi of steel in the member web, X is the ratio of the total cross-sectional area to the combined cross sectional area of both flanges, b is the widest flange width in inches, D is the clear distance between flanges in inches, t is the web thickness in inches and R is the radius in inches.

If the flange thickness exceeds 3 inches or its width exceeds 30 inches, the radius shall not be less than 1000 feet.

Heat curving of individual flange plates may be permitted subject to prior approval of the engineer.

Camber for rolled beams may be obtained by heating, but girders shall be cambered prior to heat curving by cutting the web to the prescribed arc with proper allowance for shrinkage due to cutting, welding and/or heat curving.

The Contractor shall submit a detailed procedure to the Engineer and obtain his written approval thereof prior to heat curving any beam or girder.

(6) **Color Coding**

For each approved steel used, a distinct color code shall be required. The color code shall be as specified in ASTM A 6. In addition, white shall be required for A 36 steel.

The color code used for other steels not specified in ASTM A 6 must be submitted to and approved by the Engineer.

The appropriate color(s) shall be placed on the material upon entry into the shop and shall be carried on all pieces to final fabrication. Loss of code marking on any piece and with no other positive identification shall require testing thereof prior to its use to re-establish positive identity of the material to the satisfaction of the Engineer.

(7) **Straightening Bent Material**

The straightening of plates, angles, other shapes and built up members, when permitted by the Engineer, shall be done by methods that will not produce fracture or other injury. Straightening of individual pieces shall be done prior to assembly into a built-up member. Distorted built-up members shall be straightened by mechanical means or, if approved by the Engineer, by the carefully planned and supervised application of a limited amount of localized heat, except that heat straightening of ASTM A 514/A 517 steel members shall be done only under rigidly controlled procedures, each application subject to the approval of the Engineer. In no case shall the maximum temperature of the ASTM A 514/A 517 steel exceed 1125° F, nor shall the temperature exceed 950 F at the weld metal or within 6 inches thereof. Heat shall not be applied directly on weld metal. In all other steels the temperature of the heated area shall not exceed 1150° F (a dull red). In all cases the temperature of the steel shall be controlled by approved temperature indicating devices, such as crayons, liquids or bimetal thermometers.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture. Nondestructive testing may be required by the Engineer.

Correction of errors in camber in welded beams and girders of A 514/A 517 material shall be done only under rigidly controlled procedures, each application subject to approval of the Engineer.

(8) **Pins, Pinholes and Rockers**

Pinholes shall be bored true to the specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other, unless otherwise indicated. Pins and pinholes shall be finished to ANSI surface roughness value of 125.

The diameter of the pinhole shall not exceed that of the pin by more than 1/50 inch for pins 5 inches or less in diameter or 1/32 inch for larger pins. Rockers shall be finished to ANSI surface roughness value of 250.

(9) **Shop Painting**

The application of shop paint and the cleaning and coating of sliding surfaces, pins and pinholes, with a mixture of tallow, shall conform to Item No. 722, “Paint and Painting”.

(10) **Marking and Shipping**

All structural members shall be marked in accordance with the erection diagram. The markings shall be over the painted surface. In no case shall shop paint be left off in order to preserve original markings on steel to be painted.

Members weighing more than 3 tons shall have the weight marked thereon. The loading, transporting, unloading and storing of material shall be conducted so it will be kept clean and free from injury. Bolts of each length and diameter and loose nuts or washers of each size, shall be packed separately and shipped in

boxes, crates, kegs or barrels. A list and description of the contents shall be plainly marked on the outside of each package.

### 721.5 Bolted Structures

(1) **Pitch and Edge Distance of Bolts**

Pitch and edge distance not indicated shall conform to the latest edition of AASHTO Standard and Interim Specifications for Highway Bridges.

(2) **Bolt Holes**

All holes for bolts shall be either punched or drilled. Material forming parts of a member composed of not more than 5 thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of the bolts, if the thickness of the metal is not greater than ¾ inch for carbon steel, 5/8 inch for HS or ½ inch for XHS steel. For more than 5 thicknesses or when any of the main material is thicker than shown herein, all the holes shall be subpunched or subdrilled 3/16 inch smaller and after assembling, reamed 1/16 inch larger or drilled from the solid to 1/16 inch larger than the nominal diameter of the bolts.

For punched holes, the diameter of the die shall not exceed that of the punch by more than 1/16 inch. If any holes must be enlarged to admit the bolts, they shall be reamed. Holes shall be clean cut without torn or ragged edges. Poor matching of holes will be cause for rejection.

Reamed, punched and drilled holes shall be cylindrical, perpendicular to the member and 1/16 inch larger than the nominal diameter of the bolts. Reamers and drills shall be guided by mechanical means unless otherwise approved by the Engineer. Reaming and drilling shall be done with twist drills, except that for poorly aligned holes, tapered reamers shall be used in conjunction with a template so placed and held to force the reaming to the best center of holes for that group. Connecting parts shall be assembled and held securely during reaming or drilling operations and match-marked before disassembling.

(3) **Preparation of Holes for Field Bolting**

Holes in all field splices of main truss members, box girders, continuous I-beams and plate girders shall be subpunched and reamed while assembled or drilled full size with all parts assembled, taking into account their relative position in the finished structure due to grade, camber and curvature. The assembly, including camber, alignment, accuracy of holes and milled joints, shall be approved by the Engineer before reaming or drilling full size is started.

All holes for floor beams and stringer end connections shall be subpunched and reamed to a steel template of not less than 1 inch thickness or reamed while assembled.

Holes for secondary members such as diaphragms, laterals, sway bracing, etc., may be punched full size unless otherwise approved by the Engineer.

(4) **Accuracy of Holes**

Accuracy of all holes punched full size, subpunched or subdrilled, shall be such that a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the adjoining holes in the same plane after assembling and prior to any reaming. Pieces not meeting this requirement will be rejected. Any hole which will not pass a pin 3/16 inch smaller in diameter than the nominal size of the punched hole will be cause for rejection.

After reaming or drilling, 85 percent of the holes in any adjoining group shall show no offset greater than 1/32 inch between adjacent thickness of metal.

Layout of shop work shall be done so that gage lines for bolts shall not vary from plan dimensions more than 1/16 inch. Full size holes in any adjoining group or line shall not vary more than the following:

At least 8 percent of the holes shall be within 1/16 inch of plan gage.

Not more than 10 percent of the holes may vary as much as 1/8 inch from plan gage.

Holes varying more than 1/8 inch from plan gage will not be accepted.

(5) **Shop Assembling**

Each truss or box girder section shall be assembled in its relative position in the shop before reaming is started. Match-marks shall be stamped in the metal at all field connections, conforming to erection diaphragms; at the time reaming is done.

Surfaces of metal in contact shall be cleaned before assembling.

Disassembling after reaming will be required to remove shavings, burrs, etc.

When bolting is required, prior to final bolting in the shop or field, faying surfaces of all joints including splice plates, shall be cleaned conforming to SDHPT Item 447, “Structural Bolting”.

The members shall be free from twists, bends and other deformations. In no case shall tack welding be used in assembly for bolting.

If necessary, the bolt holes shall be spear-reamed for the admission of bolts preparatory to the shop bolting of full-sized punched material. The spear reamer used for this purpose shall be not more than 1/16 inch larger than the nominal diameter of the bolts.

Parts not completely bolted in the shop shall be secured by temporary bolts, insofar as practicable, to prevent damage in shipment and handling.

The drifting done during assembling shall be only that required to bring the parts into position and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit bolts, they shall be reamed.

(6) **Bolted Connections**

High-Strength Bolts and Bolting shall conform to Item No. 720, "Metal for Structures" and SDHPT Item 447, "Structural Bolting". The same criteria shall govern all types of high-strength bolts where the plans or specifications refer to pitch, edge distance, preparation of holes, etc.

(7) **Preparation and Fit of Members**

When indicated, abutting joints shall be milled and brought to an even bearing. Where joints are not milled, the openings shall not exceed ¼ inch.

Floor beams and girders with end connection angles shall be built to exact length back to back of connection angles. If end connections are faced, the finished thickness of the angles shall be not less than that indicated.

**721.6 Welding**

(1) **General**

All welding operations, processes, equipment, materials, qualifications of welders, workmanship and inspection shall conform to SDHPT Bulletin C-5 and the Shop Drawings.

Nondestructive testing and inspection as herein described will be required for welding performed in the fabricating shop.

Unless otherwise indicated, nondestructive testing (magnetic particle and radiographic) required in the shop will be done by the Contractor and at his expense. This will include furnishing all materials, equipment, tools, labor and incidentals necessary to perform the required testing.

All magnetic particle inspection and all radiographic inspection shall be done in the presence of and at the locations selected by the Engineer or his authorized representative. The Engineer shall examine and interpret all tests made.

Magnetic particle inspection shall conform to ASTM E 709, "Dry Powder Magnetic Particle Inspection".

Unless otherwise indicated for built-up members (plates, girders, floor beams and stringers), magnetic particle inspection will be required on 100 percent of the web to flange and bearing stiffener fillet welds on not less than 1 fabricated piece (as designated by individual piece marks) for each 15 pieces or fraction thereof when the maximum flange thickness is less than 2 ½ inches and on not less than 1 piece for each 10 pieces or fraction thereof when the maximum flange thickness is 2½ inches and over. No magnetic particle inspection will be required for rolled sections. Welds requiring repairs shall be retested by magnetic particle inspection after the repairs are made.

Radiographic equipment, procedures, radiographs, identification marks, penetrameters, examina-tion, report, disposition of radiograph and weld surface preparation shall conform to SDHPT Bulletin C-5.

For shop welds of material 65,000 psi yield strength and less, radiographic inspection will be made of the full flange width of 35 percent of all flange splices where the plate thickness at the weld is 2 inches or less and of 50 percent of all flange splices where it is thicker than 2 inches and of 1/5 the depth of the web of 50 percent of the web splices on each structure. If unacceptable work is found, additional radiographs will be made on sections welded by the same equipment and/or operator just prior to and just after the section containing the defect.

For shop welds on steel that has a specified yield strength over 65,000 psi, radiographic inspection shall be made of all groove welds. These welds shall be inspected not less than 48 hours after they are completed.

Welds requiring repairs shall be retested by radiography after repairs are made. All radiographic inspection and necessary repairs shall be done prior to assembly.

When radiographic inspection of particular welds is required by the plans, this shall be in addition to the radiographic inspection required herein.

The quality of all welds shall conform to Article 203, "Quality of Welds" and repairs shall conform to Article 204, "Corrections" of SDHPT Bulletin C-5.

Dimensional tolerance, straightness and flatness of structural shapes and plates shall be within the limit prescribed above.

(2) **Preparation of Material for Welding**

Surfaces to be welded shall be smooth, uniform and free from fins, tears and other defects which would adversely affect the quality of the weld. Surfaces to be welded shall be free from loose scale, slag, rust, grease or other material. Mill scale that withstands vigorous wire brushing or a light film of drying oil or rust inhibitive coating may remain. Finish of bevels of groove welds shall be milled or ground. Oxygen cut bevels without grinding will not be allowed.

When a zinc rich paint, Protection System II, is specified, surfaces within 4 inches of a groove weld joining main stress carrying members and within 2 inches of fillet welds joining diaphragms or lateral bracing to stiffeners or gusset plates shall be sandblast cleaned and coated with linseed oil. After welding is completed, the areas shall be sandblast cleaned and painted as required for the specified paint system.

For other paint systems, surfaces within 2 inches of any weld joining main stress carrying members shall be free from any paint or other material that would prevent proper welding.

Sheared plates for webs of built-up members shall be wide enough to allow for trimming of edges where built-in camber is required. Plates with rolled edges used for webs shall be trimmed by oxygen cutting.

The faying surfaces of the web and flange plates and the adjacent surfaces that are to be fillet welded shall be cleaned by grinding prior to assembly and welding of web to flange.

(3) **Assembly of Parts**

The parts to be joined by fillet welds shall be brought into as close contact as possible, with a maximum separation of 3/16 inch. If the separation is 1/16 inch or greater, the leg of the fillet weld shall be increased by an equivalent amount. The separation between faying surfaces of lap joints and of butt joints landing on a backing strip shall not exceed 1/16 inch. The fit of joints not sealed by welds throughout their length shall be close enough to exclude water after painting. Where irregularities in rolled shapes or plates after straightening prevents this, the procedure necessary to bring them within the above limits shall be subject to the approval of the Engineer. The use of fillers is prohibited, except as indicated or as approved by the Engineer.

Members to be welded shall be brought into correct alignment and held in position by clamping, welding or tacking until the joint has been welded.

Adequate clamps must be provided to prevent cupping or warping of flanges when welding them to the web. The clamping devices must be designed to not interfere with the operation or guiding of the automatic welding equipment.

Temporary stiffeners used for jigs and/or warpage control shall not be tack welded to the flange material. Tacking to the web is permissible if the welds are at least d/6 distance away from the flange where “d” is the web depth. The tack weld shall be removed by grinding flush with the parent metal prior to acceptance.

Suitable allowance shall be made for shrinkage and the joint shall never be restrained on both sides when welding.

Abutting parts to be joined by groove welds shall be aligned carefully. Regardless of the range of stress, all shop groove welds in flange plates shall be ground smooth and flush with the base metal on all surfaces. This shall apply to both parts of equal thickness and parts of unequal thickness.

The surfaces shall be ground so that the radii at the points of transition will be 4 inches minimum.

When groove welds are used to join materials of different thickness or width, there shall be a smooth transition between offset surfaces with a slope of not greater than 1 in 4 in thickness transition and to the proper radii in the case of width transition.

Groove welds in web plates need not be ground unless indicated.

Grinding shall be done in the direction of stress and in a manner that keeps the metal below the blue brittle range (below 350° F).

Intermediate stiffeners within 12 inches of a splice point shall be shipped tack welded in place. The welding shall be done in the field after the splice is made.

(4) **End Preparation and Shop Assembly for Field Welds**

Ends of beams and girders shall be prepared in accordance with Figure 3 of 441.7 “Shop Assembly” contained in TXDOT Standard Specifications for Construction of Highways, Streets, and Bridges, Item 441 “Steel Structures” and the requirements herein or as indicated. The centerline of the land of opposing web and flange bevels shall not deviate from each other by more than 1/16 inch.

For Shop Assembly, members shall be brought into abutting contact in accordance with the blocking diagram. Root faces shall not vary in excess of 1/16 inch from contact. Corrections by additional cutting and/or grinding shall be made to bring the splice within this tolerance. Finish of bevels for groove welds shall be milled or ground. Oxygen cut bevels without grinding will not be allowed.

End preparation, backing and tolerances for single V groove welds for framing beams or girders shall conform to the details indicated or as permitted by SDHPT Bulletin C-5.

Ends of beams or girders to be welded shall be prepared in the shop taking into account their relative positions in the finished structure due to grade, camber and curvature. Each splice shall be completely shop assembled, checked and while assembled, match-marked.

**721.7 Field Erection**

(1) **Methods and Equipment**

Before starting work, the Contractor shall inform the Engineer fully of the method of erection he proposes to follow and the amount and character of the equipment he proposes to use, the adequacy of which shall be subject to the approval of the Engineer. Such approval shall not relieve the Contractor of the responsibility for the safety or adequacy of his methods or equipment or from carrying out the work in full as indicated. No work shall be done without the sanction of the Engineer.

The Contractor shall prepare and submit detailed erection plans for plate girders (bolted or welded), trusses and for all railroad underpass structures showing procedures, sequence of work, equipment to be used, falsework, etc., so that a check can be made of the adequacy of the proposed procedure. This detailed procedure shall follow the preliminary procedure previously submitted. Field erection plans for I-beam units will not be required unless indicated.

Spot welding for the purpose of eliminating field erection bolts or for holding steel parts together while bolting will not be permitted.

The Contractor shall provide the falsework and all tools, machinery and appliances, including drift pins and fitting-up bolts, necessary for the expeditious handling of the work. Drift pins sufficient to fill at least ¼ of the field holes for main connections shall be provided.

When railroad or roadway traffic must be maintained beneath girders or beams already placed, traffic shall be protected against falling objects during the

erection of diaphragms and other structural members, during the placing of cast-in-place concrete and during the erection and dismantling of forms thereof. The protection shall consist of safety nets (1 inch mesh maximum) or a flooring with opening not larger than 1 inch.

(2) **Storing Materials**

All material shall be handled in a manner to protect it from damage. Stored material shall be placed on skids above the ground and kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members, such as columns, shall be supported on skids placed closely enough to prevent excessive deflection.

(3) **Falsework**

The falsework shall be properly designed for the loads to be supported and shall be substantially constructed and properly maintained. The Contractor shall prepare and submit to the Engineer falsework plans, including calculations.

The falsework plans shall be complete in all details of members, connections, equipment, etc., so that a structural check of the plans can be made.

Approval of the Contractor's plans shall not be considered as relieving him of any responsibility.

(4) **Handling and Assembling Material**

The parts shall be assembled accurately as indicated. Match-marks shown on the erection drawing shall be shown on each member. The material shall be handled carefully so that no parts will be bent or otherwise damaged. Hammering which will injure or distort the members shall not be allowed. All bearing and faying surfaces of structural steel in bolted connections shall be cleaned before the connection members are assembled. When ASTM A 588 steel is used these surfaces shall receive a Class B blast cleaning conforming to Item No. 722, "Paint and Painting" prior to assembly of the connection members. The areas of the outside ply under washers, nuts or bolt heads shall be cleaned prior to installation of the bolts.

Unless erected by the cantilever method, truss spans shall be erected on blocking so located as to provide proper camber. The blocking shall be left in place until the tension chord splices are fully connected and all other truss connections pinned and bolted. Main connections shall have ½ of the holes filled with bolts and erection pins (½ bolts and ½ pins) before swinging the span. Splices and connections carrying traffic during erection shall have ¾ of the holes so filled.

Fit-up bolts shall be of the same nominal diameter as the connection bolts. Erection pins shall be 1/32 inch longer.

There shall be no temporary welds for transportation, erection or other purposes on main members, except at approved locations more than 1/6 the depth of the web from the flanges of beams and girders or conforming to SDHPT Standard Plan Sheet SS-MEBR, unless otherwise approved by the Engineer.

(5) **Field Welding**

Welding and nondestructive testing shall conform to Item No. 723, “Structural Welding”.

(6) **Bearing and Anchorage**

Castings, bearing plates or shoes shall not be placed upon improperly finished bridge seat bearing areas, and shall have a full and even bearing upon the concrete. Castings, bearing plates or shoes shall be placed on preformed fabric pads manufactured of all new (unused) materials and composed of multiple layers of prestressed cotton duck, 64 plies per inch of finished pad thickness, impregnated and bound with a high quality rubber compound, containing rot and mildew inhibitors and antioxidants, compounded into resilient pads of uniform thickness. The Shore Durometer hardness of the pad shall not be less than 85 nor more than 95. Pads shall be capable of withstanding 10,000 psi compressive stress without breakdown. A tolerance of ± 5 percent will be allowed from the required pad thickness. Unless otherwise indicated the required thickness of pads will be ¼ inch. Anchor bolt holes shall be not more than ¼ inch larger than the bolt diameter.

Upon completion of welding, all splices, distorted bearing pads and/or expansion shoes shall be restored to an equivalent vertical position at 70 F. This shall be done by an approved method of temporarily relieving the load on the bearing devices.

When the concrete is placed below grade, castings or bearing plates or shoes may be raised to grade on beds of Portland Cement mortar consisting of 1 part cement, 2 parts sand and a minimum amount of water. The minimum thickness of mortar bed shall be 1/8 inch and the maximum thickness shall be 3/8 inch. Adequate curing shall be provided.

When it is necessary to raise the castings or bearing plates higher above the concrete than provided by the allowable thickness of the above described materials, the area under the built-up portion shall be prepared in accordance with the specification requirements for construction joints and the buildup placed using an approved latex-based grout mixed in accordance with the manufacturer’s recommendations. Steel shims or other approved material shall be used in conjunction with one of the specified materials.

Beams and girders shall have practically full bearing on shoes and base plates. Field corrections shall be made to provide a minimum of 75 percent contact of flange to shoe with no separation greater than 1/32 inch.

Corrections by heat and pressure or through the use of tapered steel shims or layers of steel sheets shall be made to provide bearings to the tolerances given above. Small irregularities may be ground off, but care must be taken not to destroy the finish. The shims or steel sheets used shall be galvanized.

Care shall be taken to set expansion shoes normal to the direction of movement of the unit. Full line bearing of the rocker plate to the base plate shall be provided and shall be interpreted to mean full bearing on a minimum of 85 percent of the contact surfaces.

All foreign matter shall be removed from machine-finished surfaces prior to placing in the structure. Surfaces designed for sliding movement, one upon the other, shall be given a field coat of graphite spring lubricant when placed in the structure. The rolling surface of rocker shoes shall be painted.

Anchor bolts may be set to the exact location in the concrete when it is placed. Accurately cut and placed templates will be required for positioning the bolts.

In lieu of the above, anchor bolt holes shall be drilled in the exact location or may be formed by insertion of oiled and tapered wooden plugs or tapered metal sleeves into the plastic concrete. The bolts shall be set accurately and fixed in position with nonshrink grout completely filling the holes.

The location of the slotted holes in the expansion shoes in relation to the anchor bolts shall be varied with the prevailing temperature. The nuts on anchor bolts at the expansion ends of spans shall be adjusted to permit the free movement of the span and either lock nuts shall be provided or the threads of the anchor bolts burred.

In setting shoes or bearing plates for steel truss spans, proper allowance shall be made for bottom chord elongation due to dead load.

All shoes and rockers shall be set to be vertical at 70° F.

(7) **Grading Deck on Continuous Units**

Forms shall not be erected until after all welding and/or bolting is complete, the unit positioned and bearings properly set.

An accurate measurement shall be made of the elevations of girder or beam flanges at all grading control points as indicated.

Subsequent grading of forms and placing and finishing of concrete shall be governed by these measurements only, taking into account the dead load deflections of the slab and rail as indicated on the dead load deflections diagram.

(8) **Misfits**

Corrections of minor misfits and a reasonable amount of reaming will be considered a legitimate part of the operation. Any error in shop work which prevents the proper assembling and fitting-up of parts by the moderate use of drift pins or a moderate amount of reaming and slight chipping or cutting shall be reported immediately to the Engineer for his approval of the method of correction.

The correction shall be made in the presence of the Engineer, who will check the material. Such work is to be done at the entire expense of the Contractor.

### 721.8 Paint and Painting

Unless otherwise provided, the application of field paints shall conform to Item No. 722, “Paint and Painting”.

For railroad structures, which require that the steel be erected and assembled on falsework and moved into place as a unit, all field paint, except the final coat, shall be applied to the steel while on the falsework and prior to moving into final position. Surfaces inaccessible for painting in the final position shall have the final paint coat applied prior to move-in. Touch up of paint damaged due to move-in to final position shall be performed and the final field coat applied.

### 721.9 Measurement and Payment

No direct compensation will be made for “Steel Structures”. Measurement and payment for quantities of structural metal, concrete, reinforcement, railing and other bid items which constitute the completed and accepted structures shall conform to pertinent specifications.

**End**

Ref: 204, 441, 720, 722, 723

**ITEM NO. 722**
**PAINT AND PAINTING**

## 722.1 Description

This item shall govern the type and quality of paints and coatings; their source; surface cleaning and preparation; the application of the paint; protection of all traffic, property and/or persons upon, underneath or near the structure and the protection of all parts of the structure against disfigurement from any and all of the painting operations.

Surface conditions and application requirements are specified with the intent to obtain full adhesion of coatings to clean, dry metal or other surfaces to be coated and to previously applied coats. This will require careful attention to preparation of surfaces, to prevention of contamination and marring of coatings during and after drying and to uniform, skillful application of each coat of paint.

## 722.2 Materials and Systems

Paint as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers and other applied materials whether used as prime, intermediate or finish coats as indicated on painting schedule.

(1) **Prime Coat Paints**

A prime coat shall be applied to material which is required to be painted or finished and which has not been prime coated by others.

Recoating shall be performed on primed and sealed surfaces where there is evidence of suction spots, unsealed areas in first coat or damage to the prime coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

Primer is not required on items delivered shop primed.

(a) Structural Steel

This item provides for 2 basic paint systems for the prime coating of structural steel as follows:

1. Protection System I will require “brush-off-blast cleaning”, with a minimum of 4 mils dry film thickness of prime coat paint.
2. Protection System II will require “near-white-blast” cleaning, with a minimum 3.5 mils dry film thickness and a maximum 10 mil dry film thickness of prime coat paint.
3. A Special Protection System will sometimes be specified and will require the type of cleaning, the type and thickness of prime coat and other coats, as indicated.
4. For members which cannot be given a prime coat prior to installation such as steel piling, regular cleaning will be permitted when Protection System I is specified. Unless otherwise indicated, the cleaning system required for System II or Special Protection System will be required for these members when pertinent.

The prime coat for Protection System I is an oleoresinous

type paint having a moderately slow drying rate. One gallon of unthinned paint theoretically will coat 1,000 square feet with a 1 mil dry film thickness.

The prime coat for Protection System II is an organic, zinc-rich type paint. It is applied in a 2 container kit. One combined kit of paint theoretically will coat 1,000 square feet with a 1 mil dry film thickness. Characteristics such as fast dry, high pigmentation and heavy weight make mandatory the use of good application technique and agitation of the paint during application.

Unless otherwise provided in the contract, the initial cleaning and application of required prime coat shall be done by the Fabricator, prior to shipment of the steel to the job site.

(b) Exterior Surfaces

This item provides the following paint systems for the prime coating of exterior surfaces indicated:

1. Ferrous Metal
   Red Lead Pigmented Primer (FS TT-P-86) Minimum 1.5 mils dry film thickness.

2. Galvanized Steel
   Zinc Dust Zinc Oxide Primer (FS TT-P-641) Minimum 1.5 mils dry film thickness.

(c) Interior Surfaces

This item provides the following paint systems for the prime coating of the interior surfaces, as indicated:

1. Gypsum Drywall
   Interior Latex Base Primer Coat (FS TT-P-650) Minimum 6 mils dry film thickness.

2. Ferrous Metal
   Red Lead Base Primer (FS TT-P-056) Minimum 1.5 mils dry film thickness.

(2) Final Coating Paints

(a) Structural Steel

The final appearance coating for any of the prime coat systems may be aluminum, green, gray or brown as indicated, with a minimum 1.5 mils dry film thickness. Appearance coats of other colors, when required, will have the type of paint, color and mil coverage indicated.

The aluminum appearance coat (slow dry) is a standard oil base, aluminum paint. One gallon of unthinned paint theoretically will coat 900 square feet with a 1 mil dry film thickness.

The aluminum appearance coat (fast dry) is a standard lacquer base, aluminum paint, for spray application only. One gallon of unthinned paint theoretically will coat 350 square feet with a 1 mil dry film thickness.

The color appearance coats (green, gray or brown) are resin type, flat paints. These paints need to be thinned in accordance with the application conditions. They may be slow dry or fast dry according to the thinner selected. One gallon of unthinned paint theoretically will coat 775 square feet with a 1 mil dry film thickness.

(b) Exterior Surfaces

1. Ferrous Metal
   First and second finish coats shall be a high gloss alkyd enamel (FS TFE-489).
2. Galvanized Steel

   First and second coats shall be a high gloss alkyd enamel (FS TT-E-89).

(3) Condition

Paints being applied shall be mixed thoroughly and strained. They shall be completely homogeneous mixtures free of lumps, skins or agglomerates and shall contain all pigments, vehicle solids and thinners required in the original formulation. Paint containers shall be kept tightly covered and protected from the weather when not in use.

(4) Thinning

Paint may be adjusted to the correct application consistency by the use of properly applied heat not to exceed 150° F or by the use of suitable thinners.

### 722.3 Paint Designation for Structural Steel

The complete system and color required by a particular contract will be indicated as:

“Protection System I Gray”
“Protection System II Green”
“Protection System II Aluminum” or Aluminum (Fast Dry)
“Special Protection System Brown”
NOTE: Any of these colors may be designated with a particular system.

With specific written approval of the Engineer, the Contractor may substitute System II for a specified System I. When the paint system is not indicated, Protection System I Aluminum will be required.

All primary structural steel including diaphragms, laterals, finger joints and shoes shall receive cleaning and painting in accordance with the Paint System indicated. Bearing plates, exposed surfaces of steel H, sheet or metal shell piling and other miscellaneous structural steel items, except for armor joints shall be painted in accordance with Protection System I Aluminum, unless otherwise indicated. Armor joints shall be given a prime coat and field touch up prime coat only; an appearance coat will not be required.

### 722.4 Source of Supply

All paint required to comply with Federal Specifications shall be furnished with the manufacturer's labels on each can. Primers and other undercoat paint shall be produced by the same manufacturer as finish coats. Use only thinners approved by paint manufacturer and use only within recommended limits.

### 722.5 Cleaning and Preparation of Surfaces

Surfaces to be painted, whether in the shop or field, shall be completely free of oil, grease, moisture, dirt, sand, overspray, welding contamination, loose or flaking mill scale, rust or paint and free of any other conditions that will prevent the paint from forming a continuous, uniform tightly adhering film.

Loose mill scale, rust or paint shall be defined as follows:

> Mill scale, rust and paint are classified as "loose mill scale", "loose and nonadherent rust" and "loose" or "removable paint", if they can be removed from a steel surface by power wirebrushing using a commercial air or electric wirebrushing machine operated at a speed under load of 3450 RPM and equipped with a 6 inch diameter cup brush of double row knotted construction, made of No. 20 gauge music wire (Osborn Manufacturing Company, Cleveland, Ohio, Brush No. 4503 or equal). The brush shall be held against the steel surface with a force of 16 pounds and the rate of cleaning shall be 2 square feet per minute. This test must be conducted on an area not previously brushed, scraped or sanded, but from which all detrimental stratified rust (rust-scale), oil and grease, if present, have been removed. This test establishes a standard for surface preparation and shall not be considered as establishing the production rate of cleaning.

Unless otherwise provided, the inside surfaces of box members to be completely sealed shall be cleaned in accordance with regular cleaning, but shall not require painting. After all fabrication of the member is completed, its inside surfaces shall be cleaned by whatever methods necessary to remove dirt and other foreign substance which may have accumulated during assembly prior to closure. All surfaces that will not be completely enclosed shall be cleaned and painted in accordance with the required Protection System. Contact surfaces to be riveted or bolted shall not be painted.

Provide barrier coats over incompatible primers or remove and reprime as required. Notify Engineer in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

For either shop or field painting, before other cleaning operations begin, grease-like contaminants shall be completely removed with clean petroleum solvents such as cleaning naphtha, applied with clean rags so that the oil substance is actually removed and not simply diluted or spread out over a greater area. The same general requirements for painting over a clean, dry, firm surface shall be applicable to all coats.

All welds shall be flushed thoroughly with clean water and allowed to become thoroughly dry before cleaning.

Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and to be finish-painted or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

Galvanized surfaces shall be free of oil and surface contaminants cleaned with non petroleum based solvent.

(1) Regular Cleaning

Unless a particular cleaning method is specified, any effective method for removal of rust, scale and dirt, such as the use of blast-cleaning, hand or rotating metal brushes, scrapers, chisels, hammers, flame-cleaning or other means, will be acceptable.

(2) Required Blast-Cleaning

When blast-cleaning is required, the following shall apply:

(a) Near-White-Blast-Cleaning

A Near-White-Blast-Cleaned Surface Finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface. Very light shadows, very slight streaks or slight discoloration's caused by rust stain, mill scale oxides or residues of paint or coating may remain. At least 95 percent of each square inch of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration mentioned above.

(b) Brush-Off-Blast-Cleaning

When brush-off-blast-cleaning is required, the surface shall be cleaned to meet the following requirements:

A Brush-Off-Blast-Cleaned Surface Finish is defined as one from which all oil, grease, dirt, rust-scale, loose mill scale, loose rust and loose paint or coatings are removed completely, but tight mill scale and tightly-adhered rust, paint and coatings are permitted to remain provided that all surface areas to be cleaned have been exposed to the abrasive blast pattern sufficiently to expose numerous flecks of the underlying metal uniformly distributed over the entire surface.

(3) **Field Cleaning and Spot Painting**

When the erection or maintenance work is complete, including all riveting, bolting, welding, straightening of material and the Engineer has examined and approved the work, all adhering rust, scale, dirt, grease or other foreign material shall be removed and the unpainted areas cleaned in accordance with the method required under the paint system specified and painted with the required prime coat. Any surfaces from which the prime coat of paint has become worn off or in any way fails to meet specification requirements shall be cleaned and

repainted. All small cracks and cavities which were not sealed in a watertight manner by the prime coat shall be filled with a pasty mixture of the paint before the second coat is applied.

For field touch up coating on edges of plates or shapes, rivet heads, bolt heads or nuts and other parts subjected to special wear, the edges shall first be stripped with a longitudinal motion and the rivet heads, bolt heads or nuts with a rotary motion of the brush followed immediately by the general painting of the whole surface, including the edges and rivet heads.

The coating of white lead and tallow specified in Paragraph 722.6 shall be completely removed as directed for removal of grease and oil herein.

**722.6 Painting**

Paint shall not be applied to any surface containing moisture discernible with the eye or by the following test:

If temperature and humidity conditions are such that moisture is likely to condense upon the surface, a small area thereon shall be moistened with a damp cloth to apply a clearly defined, thin film of water. If this thin film evaporates within 15 minutes, the surface shall be considered safe to paint from the standpoint of continued condensation at that particular time.

Paint shall not be applied at air temperature below 40° F nor when there is likelihood of change in weather conditions within 2 hours after application which would result in air temperatures below 40° F or deposition of moisture in the form of rain, snow, condensation, etc., upon the surface. The Engineer reserves the right to require that no paint be applied when impending weather conditions might result in injury to fresh paint.

If, in the opinion of the Engineer, construction traffic produces an objectionable amount of dust, the Contractor shall, at his own expense, allay the dust for the necessary distance on each side of the structure and take any other precautions necessary to prevent dust and dirt from coming in contact with freshly painted surfaces or with surfaces before the paint is applied.

Paint shall not be applied closer than 12 inches to a surface which is to be cleaned.

(1) Application

Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

Provide finish coats which are compatible with prime paints used.

Apply additional coats when undercoats or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, weld and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.

Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

Finish exterior doors on tops, bottoms and side edges same as exterior faces.

Sand lightly between each succeeding enamel or coat.

Each coat of paint shall be applied so that it will dry to form a smooth, continuous, tightly adhering film of uniform thickness and appearance, free of brush marks, sags, runs, holidays and overspray. For all systems the dry film thickness shall be measured according to SDHPT Test Method Tex-728-I.

Spray application of the first coat of prime coat will be permitted only when the surfaces are cleaned by blasting. Except for this limitation or inability to achieve other specification requirements, all coats may be applied by roller, spray, brush or a combination thereof. Any method of application approved by the Engineer may be used to paint inaccessible areas.

All equipment used for paint application shall meet with the approval of the Engineer. Brushes shall not exceed 4 inches in width, shall be springy and not flabby and shall be kept free of contaminants. Equipment used for spray painting shall have adequate provision for separation of moisture from any air stream in contact with the paint; and all spray guns shall be adequate for the type of paint being used and shall be equipped with spray heads adequate to provide a smooth, uniform coat of paint.

All painting shall be done by skilled workmen. Application of modern specialized coatings requires workmen knowledgeable about the characteristics of the various coatings, solvents and substrates. They also must be capable of adjusting equipment and application techniques as dictated by the type paint, weather conditions, environment, size and shape of surface being painted.

(a) Prime Coat

After all fabrication work is completed and has been tentatively accepted, all surfaces to be painted shall be cleaned and painted with the required prime coat. Pieces shall not be loaded for shipment until coatings are thoroughly dry. No painting shall be done after material is loaded for shipment. Erection marks for field identification of members shall be painted upon previously painted surfaces. Surfaces to be in contact after shop riveting or bolting shall be cleaned but not painted. Unless otherwise indicated, the top flanges of girders and I-beams shall be painted.

When field rivets or high-strength bolts are required, paint shall be omitted from surfaces to be in contact after erection.

Machine finished surfaces which are in sliding contact in the structure shall be clean and coated with a hot mixture of white lead and tallow before being shipped. This refers particularly to pins and pinholes. The composition used for coating these machine finished surfaces shall be mixed in the following proportions:

4 lbs. pure tallow
2 lbs. pure white lead
1 qt. pure raw linseed oil

When Protection System II is used, surfaces within 4 inches of a weld that join main stress carrying members and within 2 inches of fillet welds, including the far side, joining diaphragms or lateral bracing to stiffeners or gusset plates shall be free of paint. These unpainted surfaces shall be blast-cleaned and coated with raw linseed oil. After welding is completed, the area shall be cleaned and painted in accordance with the required system.

When Protection System I is used, surfaces within 2 inches of a weld that join the main stress carrying members shall be free of paint. These unpainted surfaces shall be cleaned and coated with raw linseed oil. After welding is completed, the areas shall be cleaned and painted in accordance with the required system.

All surfaces, other than those mentioned, shall be painted, whether or not the surface in question will be in direct contact with concrete.

Unless otherwise indicated or exempted above, the surfaces to be shop painted will include the rolling faces of rockers and base plates, all surfaces of bearing plates and all surfaces of iron or steel castings, whether or not such surfaces are milled.

(b) Final Coatings

After all concrete has been placed and other work has progressed to the extent that marring of the appearance coat is unlikely, and all other previous paint coats, including any necessary corrective painting, has hardened completely, the required final or appearance coat may be applied. Previously applied paint film including field touch up requires a minimum of 8 days cure prior to application of appearance coat.

If concreting operations have damaged the paint, the surface shall be recleaned and repainted. Prime coated surfaces shall be cleaned to remove dirt, grease or other foreign material prior to the application of the appearance coat. Paint that has become defective shall be removed, the metal properly cleaned and the required prime coat reapplied. Excessive amounts of paint that fail to properly dry or produces blisters in the paint shall be removed and replaced in accordance with the requirements of the specified system. In no case shall a succeeding coat be applied until the previous coat and all touch up paint has dried throughout the full thickness

of the paint film. At the time of acceptance of the structure, the painted portion thereof shall present an even and uniform appearance throughout.

(2) Paint Improperly Applied

To uncover evidence of improperly applied paint, the Engineer may, at any time during construction, explore underneath the surface of any paint coats already applied. Whenever unsatisfactory conditions are found beneath applied coating films, the Engineer shall require any and all necessary remedial measures.

All paint which has been applied improperly, applied to improperly cleaned surfaces, fails to dry and harden properly, fails to adhere tightly to underlying metal or other paint film or does not evidence a normal workmanlike appearance in conformance with these specifications, shall be repaired or completely removed and replaced at the expense of the Contractor. When the final field coat does not have a uniform color and appearance throughout the structure, it shall be corrected by the use of whatever additional coats or other corrective measures found to be necessary. Freshly applied paint which has not yet set, shall be removed with the use of suitable solvents. Removal of dried paint films shall be either by means of blast-cleaning, scraping or flame torches meeting the approval of the Engineer.

### 722.7 Cleaning and Painting Existing Structures

Unless otherwise indicated, existing steel structures to be cleaned and painted shall receive the same paint schedule as that required for new structural steel. If the paint schedule for the existing structure is to be different from the new or if there is no new structural steel on the project, paint requirements will be shown as “Special Protection System” and the requirements for cleaning and painting will be listed.

### 722.8 Responsibility for Hazards

Some paints are harmful to the health. The Contractor is warned that he is responsible for the safety of his operations. This warning shall absolve the City from blame in the event of harm to persons or property from the Contractor’s cleaning, painting and storage operations.

### 722.9 Measurement and Payment

Unless otherwise indicated, the furnishing of all materials, equipment, supervision, labor, scaffolding, protection of traffic and incidentals necessary to complete the work required by this item will not be measured for payment but will be included in the unit price bid for the item or items receiving paint. Painting of existing structures will be paid for at the lump sum bid for “Painting Existing Structures”.

Payment will be made under:

| | |
|---|---|
| Painting Existing Structures | Lump Sum. |

**End**

**ITEM NO. 723**
**STRUCTURAL WELDING**

## 723.1 Description

This item shall consist of field welding of structural steel and reinforcing steel.

Provisions are made herein for the welding of the types of steel listed in Table 2, using the manual shielded metal-arc process, semiautomatic (manual) gas metal-arc welding and flux cored arc welding processes. Other welding processes may be permitted with the specific approval of the Engineer and with qualification of the welding procedure.

Shop fabrication and welding shall conform to Item No. 721, "Steel Structures" and TXDOT Bulletin C-5.

## 723.2 General

All welds including tack welds to be incorporated shall be made by a certified welder. Tack welds shall be cleaned and fused thoroughly with the final weld. Defective, cracked or broken tack welds shall be removed.

Certification for welders shall conform to TXDOT Bulletin C-6. Miscellaneous welds may be made by a welder qualified conforming to "Welder Qualification", below.

Welds shall be as indicated. The location or size shall not be changed without approval of the Engineer.

The welder shall identify groove welds made by him with paint or indelible ink.

Welding will not be allowed when air temperature is lower than 20° F, surfaces are wet or exposed to rain, snow or wind or when operators are exposed to inclement conditions that will hamper good workmanship.

Moisture present at the point of welding shall be driven off conforming with Table 3, before welding commences. Wind breaks shall be required for the protection of all welding operations.

There shall be no temporary welds for transportation, erection or other purposes on main members, except at locations more than 1/6 the depth of the web from the flanges of beams and girders as indicated or as approved by the Engineer.

ASTM A 514/517 steels shall maintain all groove welds in main members and in flanges of beams and girders subject to tensile stress or reversals of stress shall be finished smooth and flush on all surfaces, including edges, by grinding in the direction of applied stress leaving the surface free from depressions. Chipping may be used provided it is followed by such grinding. Parts joined by groove welds connecting plates of unequal thickness or width shall have a smooth transition between offset surfaces at a slope not greater than 1 in 4 with the surface of either part. The surfaces shall be ground so that the radii at the points of transition shall be 4 inches minimum.

All groove welds, except when produced with the aid of backing, shall have the root of the initial weld gouged, chipped or other-wise removed to sound metal before welding is started from the second side, except that back gouging will not be required when welding steel piling or armor joints with E 6010 electrodes. The back side shall be thoroughly cleaned before placing backup pass.

When backing for welds is left in place to become a part of the structure, it shall be a single length insofar as possible. Where more than a single length is needed, they shall be joined by full penetration butt welds. The surfaces of this butt weld shall be ground flush as necessary to obtain proper fit-up in the weld joint.

Before welding over previously deposited metal, all slag shall be removed and the weld and adjacent base metal shall be cleaned. This requirement shall apply equally to successive layers, successive beads and the crater area.

Arc strikes outside the area of permanent weld must be avoided on all steels. Where they do occur, resulting cracks and blemishes shall be ground out to a smooth contour and checked to insure soundness.

Stringer bead technique shall be used where possible for groove welds on all types of steel. Weaving will not be permitted for ASTM A 514/517 steel except in vertical welding, where a weave not exceeding 2 electrode diameters is permissible for manual shielded metal-arc process.

In all welding processes the progression for all passes in vertical welding shall be upward using a back step sequence.

Groove welds shall begin and terminate at the ends of a joint on extension bars. Edge preparation and thickness of extension bars shall be the same as that of the member being welded and shall extend a minimum of ¾ inch beyond the joint. Extension bars shall be removed with a cutting torch or arc-air gouging upon completion of the weld and the flange edges shall be ground smooth.

Any defects exposed by the grinding shall be cleaned, filled with weld metal and reground to a uniform finish. All grinding shall be parallel to the flange. Excess grinding of the parent metal shall be avoided.

### 723.3 Materials

Electrodes for manual shielded metal arc welding shall conform to the requirements of the latest edition of “Specification for Mild Steel Covered Arc-Welding Electrodes”, AWS A5.1 or to the requirements of the latest edition of “Specifications for Low Alloy Steel Covered Arc-Welding Electrodes”, ASW A5.5.

All electrodes and combination of electrode shielding for gas metal-arc welding for producing weld metal with a minimum specified yield point not exceeding 60,000 psi shall conform to the requirements in the latest edition, “Specification for Mild Steel Electrodes for Gas Metal-Arc Welding”, AWS A5.18, AWS A5.28 or “Specification for Mild Steel Electrodes for Flux Cored Arc Welding”, AWS A5.20, applicable for the classifications producing weld metal having a minimum impact strength of 20 ft/lb, Charpy V-notch, at a temperature of 0 F or below.

For weld metal with a minimum specified yield strength exceeding 60,000 psi, the Contractor shall demonstrate that each electrode and flux or combination of electrode and shielding medium proposed for use will produce low alloy weld metal having the mechanical properties listed in Table 1 in the as welded condition.

The mechanical properties shall be determined from a multiple pass weld made in accordance with the test requirements of the latest edition of AWS A5.18, AWS A5.20 or AWS A5.28 as applicable.

**Table 1**
**Required Mechanical Properties for GMAW and FCAW Electrodes**

| GMAW Grade | FCAW Grade | Tensile Strength psi Minimum | Yield Strength psi - Minimum | Elongation, % in 2 inches Minimum | Strength ft-lb at 0° F – Minimum |
|---|---|---|---|---|---|
| ER80S | E80T | 80,000 | 65,000 | 18 | 20 |
| ER90S | E90T | 90,000 | 78,000 | 17 | 20 |
| ER100S | E100T | 100,000 | 90,000 | 16 | 20 |
| ER110S | E110T | 110,000 | 98,000 | 15 | 20 |

The mechanical property tests for Grades ER100S, E100T and E110T shall be made using ASTM A 514/517 base metal.

All electrodes used on City projects shall be approved by the Engineer. Tests shall be made on electrodes of the same class, size and brand which were manufactured by the same process and with the same materials as the electrodes to be furnished. Tests must be made and approval renewed every 12 months.

For sizes of electrodes not requiring tests by AWS Specifications, test reports shall be furnished for electrodes of the nearest size and of the same classification. The request for approval shall include the manufacturer's certification that the process and material requirements were the same for manufacturing the tested electrodes and those to be furnished and new test reports, shall be submitted if any changes are made in process or materials during the effective period.

Class of electrodes required will be shown in Table 2. Electrodes shall be used with the type of current, the polarity and in the positions permitted by AWS A5.1 and A5.5 for manual shielded metal-arc welding. AWS A5.18 or A5.20 and A5.28 Specifications shall govern for gas metal-arc welding and flux cored arc welding.

**Table 2**
**Classifications of Electrodes Permitted**

| Type of Steel | Main Members Groove & Fillet Welds | | | Secondary Members Groove & Fillet Welds | |
|---|---|---|---|---|---|
| Steel Piling, | E6010 | E60T-8 | E60XX | E60T-8 | ER70S-2 |
| A 53 Pipe, | E6011 | E70S-1B | E70XX | E7XT-1 | ER70S-3 |
| A 500, | E7016 | ER70S-2 | E702-1B | E7XT-5 | ER70S-6 |
| A 501, | E7018 | ER70S-3 | E70S-2 | E7XT-6 | ER70S-7 |
| Armor Joints | | ER70S-6 | E70S-3 | E7XT-8 | |
| | | ER70S-7 | E70S-6 | | |
| | | | E70U-1 | | |
| A 36, | E7016 | ER70S-2 | E7016 | ER70S-2 | |
| A 441, | E7018 | ER70S-3 | E7018 | ER70S-3 | |
| A 572 Grade 50 | E7XT-1 | ER70S-6 | E7XT-1 | ER70S-6 | |
| A 588, | E7XT-5 | ER70S-7 | E7XT-5 | ER70S-7 | |
| A 242 Deck Plates | E7XT-6 | | E7Xt-6 | | |
| API Pipe | E7XT-8 | | E7XT-8 | | |
| A 514/A 517 | E10018M | ER1102 | E11018M | ER110S | |
| 2 ½ inches thick or less | E110T | | E110T | | |
| A 514/A 517 | E10018M | ER100S | E10018M | ER100S | |
| Over 2 ½ inches thick | E100T | | E100T | | |
| A 588, A 242 | E8018, C-3 | | E8018, C-3 | | |
| A 618 Weathering Steel | E80T(3) | ER80S(3) | E80T(3) ER80S(3) | | |
| Reinforcing Steel | E7016 | E7018 | | | |
| A 572 Grades 60 and 65 for Light Towers | E8016 E8018 | E80T ER80S | | | |

**Table 2 (continued)**
**Classifications of Electrodes Permitted**

| |
|---|
| (1) Use of the same type electrode with the next higher mechanical properties, conforming to AWS A5.1 or A5.5, than those listed will be permitted. |
| (2) In joints involving base metals of different yield points or strengths, low hydrogen electrodes applicable to the lower strength base metal may be used. |
| (3) Deposited weld metal for weathering steel shall have the following chemical composition: C, maximum percent, 0.12; Minimum percent, 0.51/1.30; P, maximum percent, 0.03; S, maximum percent, 0.04; Si, percent 0.35/0.80; Cu, percent, 0.30/0.75; Ni, percent, 0.40/0.80; Cr, percent, 0.45/0.70. |

Before use, all electrodes with low hydrogen coverings conforming to AWS A5.1 shall be dried for not less than 2 hours between 450° F and 500° F and electrodes with low hydrogen coverings conforming to AWS 5.5 for not less than 1 hour at a temperature between 700° F and 800° F. Immediately after drying, electrodes shall be stored in ovens held at a temperature of at least 250° F. E70 electrodes not used within 4 hours, E80 within 2 hours, E90 within 1 hour, E100 and E110 within 30 minutes after removal from the storage oven shall be redried before use. Electrodes with flux which has been wet, cracked or otherwise damaged, shall not be used. When ASTM A 514/517 steel is used for welding, electrodes shall be dried at least 1 hour at temperatures between 700° F and 800° F before being used. Electrodes may be redried only once.

Suitable facilities for drying and storage of electrodes shall be furnished at the job site, along with thermometers for checking and controlling the oven temperature.

In humid atmospheres, the times allowed for use without redrying may be reduced.

When a gas or gas mixture is used for gas metal-arc or flux cored arc welding, it shall be of a welding grade having a dew point of -40° F or lower. The gas manufacturer shall furnish certification to the Engineer that the gas or gas mixture is suitable for the intended application and will meet the dew point requirements.

Welding wire coils removed from the original package shall be protected or stored to keep their characteristics or welding proper-ties intact. Rusty coils or portions of coils that are rusty shall not be used.

Any deviation from the above electrode designation shall be approved by the Engineer.

### 723.4 Construction Methods

For any welding process, the parts to be joined by fillet welds shall be brought into as close as possible and shall not be separated more than 3/16 inch. If the separation is 1/16 inch or greater, the leg of the fillet weld shall be increased by the amount of the separation. The separation between faying surfaces of lap joints and of butt joints landing on backing strips shall not exceed 1/16 inch.

Splices of beams and girders joined by groove welds shall be carefully aligned with the center of gravity of both members coinciding or each flange vertically offset equally. Beams and girders with offset webs shall be fit with the webs aligned and the flanges offset laterally.

When flanges are offset or abutting parts differ a thickness or width by more than 1/8 inch, the joint shall be made with the slope of the weld metal to each surface, with a transition not exceeding 1 in 4.

Suitable allowance shall be made for shrinkage and the joint shall never be restrained on both sides in any welding process.

All butt splices shall be made before welding of diaframs or sway bracing in a particular section of a unit. Diaframs and sway bracing may be welded in a unit behind the splice welding to provide stability except where such welding interferes with butt splice adjustments such as at a drop-in segment of a continuous unit. All splices shall be made before welding of beams or girders to shoes.

For manual shielded metal-arc welding, the fit-up procedure listed below shall be used for manual shielded metal-arc welding of groove welds for butt joints:

Members shall be spaced to provide a 3/16 inch root opening at the nearest point. When at other parts of the joint the spacing provides up to and including a 7/16 inch opening correction may be made by buildup not exceeding 1/8 inch on each bevel nose. Openings exceeding 7/16 inch shall require rebeveling of the joint to bring it within the maximum buildup limits prescribed above. Build must be allowed to cool before proceeding with the welding.

All members shall be brought into correct alignment and held in position by acceptable clamps while being welded.

Deviations from the above fit-up procedure shall be approved by the Engineer.

### 723.5 Procedure

Shrinkage and distortion shall be controlled through the use of an approved procedure. Passes shall be made symmetrically and shall alternate between both sides of the joint.

For manual shielded metal-arc welding, beam and girder splices shall be made as indicated. Welds shall be alternated from side to side to prevent heat buildups on 1 flange edge. The passes must be arranged between the top and bottom flange to maintain balance and symmetry.

The sequence used in welding of splices in all I-beams shall be to first place 4 tacks (1½ to 2 inches) in the web.

For I-beam or for built-up girders, place passes 1, 2 and 3 in the top flange, followed by passes 4, 5 and 6 in the bottom flange.

Gouge out and replace passes 1 and 4, which always are placed in the over position before welding on the web. Next, place passes 7 and 8 in the web after aligning girder webs with short tacks at approximately 8 inches on centers.

Alignment clamps may be removed when sufficient weld has been placed to hold the members together and welding is completed using the sequence indicated.

When welding the root passes of beam and girder splices, E7010 electrodes may be used, provided the work is preheated con-forming to Table 3. After the root passes are

backed up, the E7010 electrode pass shall be completely removed by arc-air gouging and replaced using low hydrogen electrode.

When this procedure is used, it shall be a continuous operation and back gouging and rewelding shall be completed on each splice before starting on another one. The use of E7010 electrodes will not be permitted for welding ASTM A 514/A 517 steel.

For haunch girder splices adjacent to the haunch section, the welding, once started, shall be continuous until a minimum of 50 percent of the welding in both flanges is completed.

Deviation from the above sequence of weld passes shall be approved by the Engineer.

Procedures for all gas metal-arc and flux cored arc welding shall be submitted to the Engineer for approval and shall be qualified prior to any field welding.

All gas metal-arc and flux cored arc welding procedures shall be qualified conforming to Sections 5 and 7 of TXDOT Bulletin C-5. For each joint to be used in construction, the joint details, electrode classification or grade, electrode diameter, voltage, amperage, travel speed, order and relative position of passes, number and thickness of layers, gas flow, dew point of gas, back gouging, method of cleaning and other pertinent information shall be clearly presented in the Procedure Specification. Fillet welds shall conform to details indicated.

Procedures for welding on ASTM A 514/A 517 steel shall be qualified conforming to TXDOT Bulletin C-5 and approved by the Engineer prior to starting work. Variables to be reported shall include welding process, plate thickness, grade of steel, weld position, joint details, type and size of electrode, number and location of passes, welding sequence, back gouging, current and voltage per pass, welding speed, heat, input and maximum interpass temperature. The heat input and maximum interpass temperature shall not exceed the recommendations of the Steel Producer.

The classification and size of electrode, arc length, voltage and amperage shall be suitable for the thickness of the material, type of groove, welding positions and other circumstances attending the work.

(1) Manual Shielded Metal-Arc Welding Process

(a) The maximum size of electrode shall be as follows provided the welder has been certified for its use by the City:

1. 5/16 inch for all welds made in the flat position except root passes.
2. ¼ inch for horizontal fillet welds.
3. ¼ inch for root passes of fillet welds made in the flat position and of groove welds made in the flat position with backing and with a root opening of ¼ inch or more.
4. 5/32 inch for welds made with EXX14 and low hydrogen electrodes in the vertical and overhead positions.
5. 3/16 inch for root passes of groove welds and for all other welds not included under 1, 2, 3 and 4 above.

(b) The root pass size shall be large enough to prevent cracking. The maximum thickness of layers subsequent to the root pass in fillet welds and of all layers in groove welds shall be:

1. ¼ inch for root passes of groove welds.
2. 1/8 inch for subsequent layers of welds made in the flat position.
3. 3/16 inch for subsequent layers of welds made in the vertical, overhead and horizontal positions.

(c) The maximum size fillet weld which may be made in one pass shall be:

1. 3/8 inch in the flat position.
2. 5/16 inch in horizontal or overhead positions.
3. ½ inch in the vertical position.

(2) Manual (Semiautomatic) Gas Metal-Arc Welding and Flux Cored Arc Welding Process

(a) The maximum size electrode used shall be as follows:

1. 5/32 inch for the flat and horizontal positions.
2. 3/32 inch for the vertical position.
3. 5/64 inch for the overhead positions.

(b) The thickness of weld layers, except root and surface layers shall not exceed ¼ inch. When the root opening of a groove weld is ½ inch or greater, a multiple pass split-layer technique shall be used. The split-layer technique shall be used. The split-layer technique shall be used in making all multiple pass welds when the width of the layer exceeds 5/8 inch for gas metal-arc welding or ¾ inch for flux cored arc welding.

(c) The welding current, arc voltage, gas flow, mode of metal transfer and speed of travel shall be such that each pass will have complete fusion with adjacent base metal and weld metal and there will be no overlap, excessive porosity or undercutting.

(d) Gas metal-arc welding or flux cored arc welding with external gas shielding shall not be done in a draft or wind. An approved shelter of a material and shape capable of reducing the wind velocity in the vicinity of the welding to a maximum of 5 miles per hour shall be furnished by the Contractor

(e) The maximum size of a fillet weld made in 1 pass shall be:

1. ½ inch for the flat and vertical position.
2. 3/8 inch for the horizontal position.
3. 5/16 inch for the overhead position.

(3) Preheat

Preheat ahead of welding both groove and fillet welds (including tack welding) will be required as shown in Table 3.

Preheat and interpass temperatures must be sufficient to prevent crack formation. The preheat temperatures shown in Table 3 are minimums and higher preheats may be necessary in highly restrained welds.

When the base metal is below the required temperature, it shall be preheated so the parts being welded are not less than the specified temperature within 3 inches of the point of welding.

For all groove welds, reheat temperature shall be measured on the side opposite to which the heat is applied at points about 3 inches away from the joint.

Preheating equipment shall be adequate to maintain the entire joint at or above the specified temperature. When possible, a joint shall be completely welded before it is allowed to cool below the specified temperature but shall always be welded sufficiently to prevent cracking before cooling is permitted.

Usually preheat and interpass temperatures shall not exceed 400° F for thickness up to 1 ½ inches and 450° F for greater thickness. These temperatures shall never be exceeded on ASTM A514/517 steels.

The welder shall have and use approved equipment for checking preheat and interpass temperatures at all times while welding is in progress.

**Table 3**
**Minimum Preheat and Interpass Temperature for Manual Shielded Metal-Arc Welding, Flux Cored Arc Welding or Gas Metal-Arc Welding**

| | Manual or Semiautomatic Gas Metal-Arc Welding, Flux Cored Arc Welding or Manual Shielded Metal-Arc Welding with Low Hydrogen Electrodes | |
|---|---|---|
| Thickness of Thickest Part at Point of Welding | ASTM A 36; A 242; A 441 A 572 Grades 42, 45 and 50; A 588 | ASTM A 514/517 |
| To ¾ inch, incl. | 50° F | 50° F |
| Over ¾ inch to 1 ½ inches, incl. | 70° F | 125° F |
| Over 1 ½ inches to 2 ½ inches, incl. | 150° F | 175° F |
| Over 2 ½ inches | 225° F | 225° F |

1. These temperatures are the minimum required for the thinner material shown for each increment and higher preheat on a step basis will be required for the thicker material within each increment. Preheat and interpass temperatures must be sufficient to prevent crack formation and welding shall be carried continuously to

completion or to a point that will assure freedom from cracking before the joint is allowed to cool below the minimum specified preheat and interpass temperature. Temperature above those shown may be required for highly restrained welds.

2. When E7010 electrodes are permitted for tacking or temporary root pass, the material shall be pre-heated according to the following:

| Thickness of Thickest Part | Preheat for Tacking or Temporary Root Pass |
|---|---|
| ½ inch and less | 150° F |
| 9/16 inch through ¾ inch | 200° F |
| 13/16 inch through 1½ inches | 300° |
| Over 1½ inches | 400° |

3. When joining steels of different strengths or thickness with groove welds, the preheat and interpass temperatures for the higher strength steel and the average plate thickness shall be used. For fillet welds, the preheat shall be used for the higher strength steel and the thickest plate being welded.

4. When the base metal temperature is below 32° F, preheat to at least 70° F and maintain this minimum temperature during welding.

5. Heat input when welding A 514/517 steel shall not exceed the steel producer's recommendations.

6. When moisture is present on the base metal it shall be preheated to 200° F before welding is started.

### 723.6 Quality of Welds

Weld metal shall be sound throughout.

There shall be no cracks in any weld or weld pass.

There shall be complete fusion between the weld metal and the base metal and between successive passes throughout the joint.

Welds shall be free from overlap and the base metal free from undercut more than 1/100 inch deep when its direction is transverse to the primary stress in the part that is undercut. Undercut shall not be more than 1/32 inch deep when its direction is parallel to the primary stress in the part that is undercut.

All craters shall be filled to the full cross section of the welds.

All welds on ASTM A 514/517 steel shall be visually examined for longitudinal or transverse cracks not less than 48 hours after completion of welding.

### 723.7 Corrections

When welding is unsatisfactory or indicates inferior workmanship, the following corrective measures will be required by the Engineer whose specific approval shall be obtained for making each correction.

When requirements prescribe the removal of part of the weld or a portion of the base metal, removal shall be by oxygen gouging or arc-air gouging.

Oxygen gouging shall not be used on ASTM A 514/517 steel or for A 588 weathering steel.

Backgouging of splices in beams and girders or cutouts of defective welds shall be done by arc-air gouging by a welder qualified to make beam and girder splices.

Where corrections require the deposition of additional weld metal, the sides of the area to be welded shall have sufficient slope to permit depositing new metal.

Defective or unsound welds shall be corrected either by removing and replacing the entire weld or as follows:

1. Excessive convexity. Reduce to size by grinding off the excess weld metal.
2. Shrinkage cracks. Cracks in base metal, craters and excessive porosity. Remove defective portions of base and weld metal down to sound metal and replace with additional sound weld metal.
3. Undercutting, undersize and excessive concavity. Clean and deposit additional weld metal.
4. Overlapping and incomplete fusion. Remove and replace the defective portion of weld.
5. Slag inclusions. Remove the parts of the weld containing slag and replace with sound weld metal.
6. Removal of adjacent base metal during welding. Clean and form full size by depositing additional weld metal.

Where corrections require the deposition of additional weld metal, the electrode used shall be smaller than that used for making the original weld. Surfaces shall be cleaned thoroughly before rewelding.

A cracked weld shall be removed throughout its length, unless the extent of the crack can be ascertained to be limited, in which case the weld metal shall be removed 2 inches beyond each end of the crack and repairs made.

Where work performed after the making of a deficient weld has made the weld inaccessible or has caused new conditions making the correction of the deficiency dangerous or ineffectual, the original conditions shall be restored by removal of welds or members or both, before making the necessary corrections or else the deficiency shall be compensated by additional work ac-cording to a revised design approved by the Engineer.

Improperly fitted and misaligned parts shall be cut apart and rewelded.

Members distorted by the heat of welding shall be straightened by mechanical means or by the carefully supervised application of a limited amount of localized heat. Heated areas shall not exceed 1200° F as measured by Tempil-sticks or other approved methods for steel up to 65,000 psi yield strength. Parts to be heat straightened shall be substantially free of stress from external forces, except when mechanical means are used in conjunction with the application of heat.

Heat straightening of A 514/517 steel shall be done only under rigidly controlled procedures, subject to the approval of the Engineer. In no case shall the maximum temperature of the steel exceed 1100° F. Sharp kinks and bends shall be cause for rejection of the material.

### 723.8 Radiographic Inspection

Radiographic testing required in the field shall be done at the expense of the Contractor by an approved laboratory as defined by "General Conditions" having prior approval of the Engineer. The testing shall include furnishing all materials, equipment, tools, labor and incidentals necessary to perform the required testing. The Owner may require further tests as necessary conforming to "General Conditions" and may perform additional testing including other types.

Radiographic equipment, procedures, resulting radiographs, identification marks, penetrameters, examination, reports and weld surface preparation shall conform to TXDOT Bulletin C-5. The Engineer will examine and interpret the resulting radiographs.

Radiography shall be done within the time interval specified by the Engineer. Field welds on ASTM A 514/517 steel shall not be radiographed until a minimum of 48 hours after completion of the weld.

When so indicated, welded butt splices shall be radiographed. Radiographic testing shall be as indicated in "Radiographic Inspection", above. Weld quality shall be as follows:

> There shall be no cracks and the sum of the greatest dimension of porosity and fusion type defects shall not exceed 1/10 of the nominal bar diameter in inches. The Engineer will examine and interpret the resulting radiographs, which shall become the property of the Owner and remain with the Engineer.

For field welds of splices in material with a specified yield strength of less than 65,000 psi, radiographic inspection will be made of the full flange width of 25 percent of all flange splices and of 1/3 the depth of the web of 25 percent of all web splices on each structure (17 inches minimum length). If unacceptable work is found, an additional radiograph (penalty shot) shall be made on a section welded by the same operator just prior to and just following the section containing the defect. Welds requiring repairs shall be retested by radiography after repairs are made. Necessary repairs shall be made prior to any further work being done.

For field welds of splices in material with a specified yield strength greater than 65,000 psi, radiographic inspection shall be made on all flange and web splices. Welds requiring repairs shall be retested by radiography a minimum of 48 hours after repairs are made.

All radiography (penalty shots and retakes) required because of unacceptable welding shall be performed at the expense of the Contractor.

When radiographic inspection of particular welds is indicated, this shall be in addition to the radiographic inspection required herein.

All resulting radiographs shall become the property of the Owner and remain with the Engineer.

All groove welds designed to carry primary stresses shall be subject to radiographic inspection. When subjected to such inspections, the presence of any of the following defects in excess of the limits indicated will result in rejection of the defective weld until corrected.

1. Sections of welds shown to have any cracking, regardless of length or location, incomplete fusion, overlapping or inadequate penetration shall be judged unacceptable.
2. Inclusions less than 1/16 inch in greatest dimension including slag, porosity and other deleterious material, shall be permitted if well dispersed so that the sum of the greatest dimensions of the inclusions in any linear inch of welded joint shall not exceed 3/8 inch.
3. Inclusions 1/16 inch or larger in greatest dimension shall be permitted provided such defects do not exceed the limits indicated or described above.
4. There shall be no inclusion greater than 1/16 inch within 1 inch of the edge of part or member at the joint or point of restraint.

### 723.9 Reinforcing Steel

Provisions are made herein for the welding of reinforcing steel by the manual shielded metal-arc process. Other processes may be permitted with the specific approval of the Engineer or may be specified on the plans. When the Cadwell process is permitted, a "C" series splice shall be used with grade 40 reinforcing steel and a "T" series splice shall be used with grade 60 reinforcing steel, unless otherwise indicated.

(1) **Base Metal**

Reinforcing steel to be welded shall be new billet steel conforming to ASTM A 615 and to the following chemical composition:

| | |
|---|---|
| Maximum Carbon | 0.40 Percent |
| Maximum Manganese | 1.30 Percent |

Mill test reports will be required conforming to Item No. 406, "Reinforcing Steel".

(2) **Filler Metal**

Low hydrogen electrodes as specified in Table 1 shall be required for all welding of reinforcing steel. Drying of electrodes shall be as specified in "Materials", above.

### 723.10 Preheat and Interpass Temperature

Minimum preheat and interpass temperatures shall be as shown in Table 4.

**Table 4**
**Preheat and Interpass Temperature for Reinforcing Steel**

| Carbon Range | No. 7 & Smaller | No. 8 & Larger |
|---|---|---|
| Up to and including 0.30 | None | 100° |
| 0.31 to 0.35 inclusive | None | 150° |
| 0.36 to 0.40 inclusive | 100° | 250° |
| Unknown | 250° | 400° |

For widening projects, use carbon content and bar size of new steel to determine preheat required.

### 723.11 Joint Types

For all bars No. 8 and larger, butt splices will be required. For No. 7 bars and smaller, lap splices will be required.

Fillet welds in lap splices shall be a minimum of 4 inches in length and shall be welded on each side of the lap joint. For bars No. 5 and smaller, welding from one side of the lap will be permitted by the Engineer, when it is impractical to weld from both sides of the joint, but in this case the weld shall be a minimum of 6 inches in length.

Lap welds shall conform to Table 5.

Where possible, all butt splices shall be made in the flat position. All welds for butt splices, except horizontal welds on vertical bars shall be as indicated. The backup strip will be required when access to the splice is from the top only. When bars may be rotated or access to the splice is available from two sides the double bevel splice may be made and this type weld requires gouging out the root pass similar to a flange splice on structural steel. The root pass may be made using E7010 electrodes for all double beveled splices and the root pass shall be completely removed prior to welding the opposite side. The steel shall be preheated to 400° F if E7010 electrodes are used. Horizontal splices, on vertical bars, shall be as indicated.

**Table 5**

| Bar Size | a | b Maximum | t Minimum | c Maximum | Electrode Size |
|---|---|---|---|---|---|
| No. 4 | .04 inch | 1/8 inch | 1/8 inch | 1/16 inch | 1/8 inch |
| No. 5 | .05 inch | 1/8 inch | 3/16 inch | 1/16 inch | 5/32 inch |
| No. 6 | .06 inch | 1/8 inch | | 1/16 inch | 5/32 inch |
| No. 7 | .07 inch | 3/16 inch | 5/16 inch | 1/16 inch | 5/32 inch |

### 723.12 Widening Projects

In general, the new reinforcing steel shall be either lap or butt spliced directly to the bar to be extended. When the reinforcement in the old portion of a structure is found to be of the wrong spacing, dowel bars long enough to develop the welded lap or butt splice and also develop the bar in bond, conforming to Item No. 406, "Reinforcing Steel", shall be welded to the old steel and the new reinforcement placed at the correct spacing without welding to the old steel. No measurement or payment will be made for the dowels but will be subsidiary to the other items in the contract.

Both old and new reinforcement shall be cleaned thoroughly prior to the preparation of the joint.

### 723.13 Welder Qualification

All welders shall be certified before working on any material which is to be incorporated into a City project, except for miscellaneous welds as defined below. Each welder must have certification papers showing the type of work for which he is certified con-forming to TXDOT Bulletin C-6 and will not be permitted to do any type of work not covered by such papers.

Miscellaneous welds of the following types may be made by a welder who is certified for structural or reinforcing steel or a qualified welder:

> Armor joints and their supports, Screed Rail and Form Hanger Supports where permitted on Steel units, Reinforcing Steel to R-Bars for lateral stability between Prestressed Beams, Spirals or Bands to reinforcing Bars in Drilled Shaft cages, permanent Metal Deck forms, additional steel added in railing when slip form construction is used and other similar miscellaneous members that have no load carrying capacity in the completed structure.

A qualified welder is an experienced welder who is capable of making welds of sound quality, but does not have certification papers. Prior to welding operations, the Engineer or a representative of the Engineer shall check the welder's ability by a job site Miscellaneous Weld Qualification Test. The Contractor shall furnish all of the material and equipment necessary for the test.

The miscellaneous Weld Qualification Test shall consist of the following:

> The welder shall make a single pass fillet weld in the vertical position ¼ inch maximum size approximately 2 inches long on ½ inch plate using 5/32 inch low hydrogen electrodes in the position indicated. The welder shall stop and start again within the 2 inch length of fillet weld.
>
> The specimen shall be visually examined and the fillet weld shall present a reasonably uniform appearance free of cracks, overlap and undercut. There shall be no porosity visible on the surface of the weld.
>
> The specimen shall be ruptured as indicated by the application of a force or by striking with a hammer.

The fractured surface of the weld shall show complete penetration into the root of the joint and shall exhibit no incomplete fusion to the base metal nor any inclusion or porosity larger than 3/32 inch in its greatest dimension.

If a welder fails to meet the requirements of this test, a retest may be allowed under the following conditions:

An immediate retest may be made consisting of 2 test welds, as described above and both test specimens shall meet all of the requirements specified.

A retest may be made after 30 days, provided there is evidence that the welder has had further training or practice. In this case the test shall be a single specimen.

Qualification by the test herein specified for miscellaneous welding shall be effective immediately upon satisfactory completion thereof and shall remain in effect for the duration of the project.

Before welding on ASTM A 514/517 steel, each welder must present evidence, satisfactory to the Engineer, that he has had at least 3 months satisfactory experience welding this type of steel over 1 inch thick. In lieu of such experience, each welder, providing he has previously qualified for welding with low-hydrogen electrodes or has used the proposed welding process, shall have completed a training course in welding ASTM A 514/517 steel prior to taking the welder qualification test.

Tests for certification of welders for manual shielded metal-arc welding shall conform to TXDOT Bulletin C-6. Tests shall be given by an approved laboratory. For field welding, certification by an approved laboratory will be accepted for a period of 1 month from the time of certification. During this period, the welder will be permitted to work on City projects provided his work is satisfactory. If his work is satisfactory during this period, the City will issue him certification papers which will permit the welder to work on City projects as long as he continues to do satisfactory work.

A welder must have passed the Basic Qualification Test for Structural Welding in the vertical (3G) and overhead position (4G) conforming to TXDOT Bulletin C-6 prior to welding on any load carrying members. Also, he must demonstrate to a City welding inspector a thorough knowledge of the required welding procedures together with his ability and desire to follow them and make welds of sound quality and good appearance. Quality of the welds will be checked by radiography.

To work on field splices of beams and girders, a welder must be certified for and be capable of making groove welds in both the vertical and overhead position when using the manual shielded metal-arc process.

For manual (semiautomatic) gas metal-arc welding or flux cored arc welding, welder qualification tests for certification shall qualify conforming to TXDOT Bulletin C-5 and tested conforming to TXDOT Bulletin C-6 as follows:

1. Basic Test Certification for groove welds for unlimited thickness material will also qualify a welder for any equal or lower strength steel or for fillet welding in the position in which he is certified using the same electrode and combination of shielding used for the test.

2. Welders shall be certified in the vertical and overhead position to work on field splices of beams or girders.

3. Tests for certification shall be given by an approved laboratory. Certification papers for gas metal-arc welding or flux cored arc welding issued by an approved laboratory will be handled in a manner similar to that used for the manual shielded metal-arc process.

4. Welders shall be qualified for each process to be used. Qualification for flux cored arc welding will not qualify a welder for gas metal-arc welding or vice versa.

5. Qualification for welding with any grade electrode will automatically qualify a welder for the use of lower grades of electrodes using the same process, i.e., qualification with Grade ER80S/E80S electrode will qualify for Grade ER70S, but not vice versa.

The certification papers issued by the City are the property of the City and may be canceled at any time.

Radiographic inspection shall be made of all qualification test plates of groove welds for the "Basic Qualification Test". If this inspection indicates any lack of fusion, incomplete penetration and defects 1/16 inch or larger in greatest dimension or if the sum of the greatest dimensions of defects less than 1/16 of an inch in greatest dimension exceeds 3/8 inch in any linear inch of weld, the weld shall be considered as failing the soundness test. This radiographic inspection shall apply only to that portion of the welds between the discard strips of the specimens as indicated in Figures 13 and 14 of Appendix B of TXDOT Bulletin C-6. The specimen plates shall be wide enough to provide a minimum of 6 inches of effective weld length for radiographic testing. Mechanical testing shall conform to TXDOT Bulletin C-6.

### 723.14 Measurement and Payment

No measurement or payment will be made under this item for the work prescribed but shall be considered subsidiary to the various other bid items called for in the contract.

**End**

Ref: 406, 721

**ITEM NO. 725**
**SURVEY MARKERS**

## 725.1 Description

This item shall consist of the installation of type of survey markers furnished by the City at locations indicated on the Drawings or as directed by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

## 725.2 Submittals

The submittal requirements of this specification item include:

A. Class A p.c. concrete mix design,

B. Type of survey marker and associated construction details.

## 725.3 Materials

Survey marker types A, B and C shall be cast metal anchor plates that are provided by the City of Round Rock Department of Public Works and Transportation or successor department. The completed survey markers are used for future survey reference markers.

Type A survey makers (Standard Detail No. 725-1) shall be used on all City of Round Rock Capital Improvement Projects (CIPs), while types B (Standard Detail No. 725-2) and C (Standard Detail No. 725-3) shall be used on all subdivisions within the City of Round Rock Extra Territorial Jurisdiction (ETJ). A type C marker shall be used for all aerial mapping projects.

For CIP Roadway Construction Projects a type A survey monument shall be installed within an adjustable valve box (Standard Detail No. 725S-11) and anchored in Class A p.c. concrete (Standard Detail No. 725S-10). All other survey markers shall be anchored in a p.c. concrete mass (Standard Detail No. 725S-7) with minimum dimensions of 12 inches (300 mm) in width and 18 inches (450 mm) in depth, unless directed otherwise by the Engineer or designated representative.

## 725.4 Construction Methods

Survey markers of the type specified shall be installed complete in place at locations indicated on the Drawings or as directed by the Engineer or designated representative. They shall be properly referenced by a Registered Professional Land Surveyor licensed in the State of Texas and set at locations that are clear of obstructions that would interfere with the setup of tripods and survey instruments over the marker.

## 725.5 Measurement

Survey markers shall be measured per each marker type, installed complete in place as described in the Construction Methods section above (725.4).

**725.6 Payment**

This item shall be paid for at the unit bid price per each type of Survey Marker, installed complete in place. The unit bid prices shall include full compensation for all materials, p.c. concrete, labor, workmanship, equipment and incidentals necessary to complete the work, including excavation for installation of the survey marker and p.c. concrete and restoration of the site to the condition necessary for construction of sidewalk or other structures around the survey marker.

Payment will be made under:

| | |
|---|---|
| Type A Survey Identification Marker | Per Each. |
| Type A Survey Identification Marker with Adjustable Valve Box | Per Each. |
| Type B Survey Identification Marker | Per Each. |
| Type C Survey Identification Marker | Per Each. |

**End**

| ***SPECIFIC*** CROSS REFERENCE MATERIALS |
|---|
| Specification 725, “SURVEY MARKERS” |

City of Round Rock Standard Specifications

| Designation | Description |
|---|---|
| Item No. 403 | Concrete for Structures |

City of Round Rock Standard Details

| Designation | Description |
|---|---|
| Item No. 725-1 | Monument, Type A Survey Identification Marker |
| Item No. 725-2 | Monument, Type B Survey Identification Marker |
| Item No. 725-3 | Monument, Type C Survey Identification Marker |
| Item No. 725-7 | Survey Identification Marker, Non Traffic Construction Detail |
| Item No. 725-10 | Survey Identification Marker, Roadway Traffic Construction Detail |
| Item No. 725-11 | Adjustable Valve Box for Survey Monument |

| ***RELATED*** CROSS REFERENCE MATERIALS |
|---|
| Specification 725, “SURVEY MARKERS” |

City of Round Rock Standard Specifications

| Designation | Description |
|---|---|
| Item No. 401 | Structural Excavation and Backfill |