

SECTION 504

STEEL STRUCTURES

504-1.01 DESCRIPTION. Construct steel structures and the structural metal portions of composite structures according to the Plans.

Furnish, fabricate, erect, and coat structural metals shown on the Plans, including structural steel of all grades, bolts and fasteners, stud shear connectors, welding, special and alloy steels, metallic electrodes, steel forgings and castings, and iron castings. Furnish, fabricate, and install incidental metal construction and elastomeric material not otherwise provided for, according to the Contract.

504-2.01 MATERIALS. Use materials that conform to the following:

Paint	Subsection 708-2.01
Structural Steel	Section 716
Arc Welding Electrodes	Section 716
Bolts, Nuts and Washers	Section 716
Steel Grid Floors	Section 716
Steel Pipe	Section 716
Galvanized Metal	Section 716
Steel Forgings	Section 718
Steel Pins & Rollers	Section 718
Castings	Section 719
Elastomeric Bearing Pads	Section 720
Polytetrafluoroethylene (PTFE) Bearings	Section 720
Epoxy Adhesive for Elastomeric Bearing Pads	Section 720

With written approval, substitute a grade of steel, for that specified, for a particular application where it is desired. Substituted steel must be equal or superior in both physical and chemical properties.

~~**504-2.02 TEFLON COATED BEARINGS.** When shown on the Plans, furnish bearings with a 3/32 inch thick pad of filled Poly-Tetrafluoroethylene (TFE), bonded to the sliding surfaces of the sliding plates, by the manufacturer.~~

~~Use a TFE pad meeting the following requirements:~~

TFE PAD REQUIREMENTS

Tensile Strength, minimum	2000 psi
Tensile Elongation, minimum	200%
Hardness	55-65 Shore D
Coefficient of Friction (TFE against Stainless Steel), maximum	0.08 (for loads greater than 1000 psi and speeds less than 1 inch/min.)
Compressive Strength (0.2% offset), minimum	1800 psi
Shear Strength (between TFE and steel	400 psi

Milled ends of compression members, stiffeners, and fillers	ANSI 500
Bridge rollers and rockers	ANSI 250
Pins and pin rockers	ANSI 125
Slide bearings	ANSI 125

Face and bring to an even bearing abutting joints in compression members and girder flanges, and in tension members where specified on the drawings. Where joints are not faced, keep the opening at 1/4 inch or less.

Build floor beams, stringers, and girders with end construction angles to the exact length shown on the Plans, as measured between the heels of the connection angles. The permissible tolerance is plus 0 inch to minus 1/16 inch. Where continuity is required, face end connections.

Cold bend load-carrying rolled-steel plates as follows:

Take the rolled-steel plates from the stock plates so that the bendline is at right angles to the direction of rolling.

Bend until the radius of the bends, measured to the concave face of the metal, is not less, and preferably more, than shown in the following table, where T is the thickness of the plate.

Angle Through Which Plate is Bent	Minimum Radius
61-90 degrees	1.0 T
91-120 degrees	1.5 T
121-150 degrees	2.0 T

If a shorter radius is essential, bend the plates when hot, but not shorter than a radius of 1.0 T.

Before bending, round the edges of the plate to a radius of 1/16 inch throughout the portion of the plate to be bent.

Fit up and attach end and intermediate stiffeners as shown on the Plans. Do not weld ends of stiffeners and other attachments to flanges unless shown on the Plans.

[Furnish 30 days notice of when and where fabrication work is anticipated and give at least 48 hours notice before work will begin at the fabrication shop to allow for inspection.](#)
~~Where called for on the Plans, stress relieve welded members according to the requirements of the AWS specifications.~~

3. Shop Splices. In addition to those shown on the Plans, girder webs and flanges may contain a maximum of 2 shop splices per plate per span. Indicate all splices on the shop drawings. These splices are subject to approval and are subject to the following limitations:

Make splices complete penetration butt welds. Grind flange splices flush. Grind web splices flush on the outside face of exterior girders only. Grind parallel to the longitudinal axis of the girder.

Do not place a bottom flange splice within the middle third of any span. Use tension flange splices only as shown on the Plans or as approved.

Completely weld each element of a girder, such as flange or web, before attaching it to another element.

Make all splices at least 6 inches from the nearest stiffener plate. Offset web and flange splices at least 6 inches.

4. Reserved.

~~4. Pins and Rollers. Turn pins and rollers to the dimensions shown on the drawings. Keep them straight, smooth, and free from flaws.~~

~~In pins larger than 9 inches in diameter, bore a hole at least 2 inches in diameter full length along the axis. Bore the hole after the forging has cooled to a temperature below the critical range and before it is annealed. Bore under conditions that prevent injury from too rapid cooling.~~

~~Bore pin holes true to the specified diameter, smooth and straight, at right angles with the axis of the member, and parallel with each other. Finish cut the final surface.~~

~~Do not vary the distance outside to outside of holes in tension members and inside to inside of holes in compression members more than 1/32 inch from that specified. Bore the holes in built-up members after completing the assembly.~~

~~The diameter of the pin hole must 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.~~

~~Furnish 2 pilot nuts and 2 driving nuts for each size of pin.~~

5. Bolt Holes. Either drill or punch bolt holes. Make finished bolt holes 1/16 inch larger than the nominal diameter of the bolt. Ensure holes are clean cut and without burrs or ragged edges. Material with poorly matched holes will be rejected.

When material forming parts of a member is composed of not more than 5 thicknesses of metal, and whenever the thickness of the metal is not greater than 3/4 inch for structural carbon steel or 5/8 inch for alloy steel, either punch or drill the holes to full size.

When there are more than 5 thicknesses or when any of the main material is thicker than 3/4 inch in carbon steel, or 5/8 inch in alloy steel, or when required under paragraph 5 below, subpunch or subdrill the holes 3/16 inch smaller. After assembling, ream them to size or drill them from the solid to full size.

For punched holes, the diameter of the die must not exceed the diameter of the punch by more than 1/16 inch. Ream any holes that must be enlarged to admit bolts.

Ream holes cylindrical and perpendicular to the member. Direct reamers mechanically, where practicable.

Ream and drill using twist drills. Assemble connecting parts requiring reamed or drilled holes and securely hold them while reaming or drilling them. Match mark them before disassembling.

Subpunch (or subdrill if required) holes for field connections and field splices of arch members, continuous beams, towers (each face), bents, plate girders, and rigid frames while assembled in the shop. ~~of main truss or arch members, continuous beams, towers (each~~

~~face), bents, plate girders, and rigid frames while assembled in the shop according to paragraph 9 of this Subsection.~~ Obtain approval of the assembly, including camber, alignment, and accuracy of holes and milled joints before beginning reaming.

Subpunch and ream holes for floor beam and stringer field end connections to a steel template, or ream them while assembled. When partial assembly is permitted, ~~as provided in paragraph 9 of this Subsection,~~ ream holes for web member connections to steel templates.

When using templates to ream field connections of web members of an truss, arch, bent or tower, mill or scribe at least one end of each web member normal to the long axis of the member. Accurately set the templates at both ends from this milled or scribed end. ~~Accurately set and locate templates for reaming gussets of a truss before reaming or drilling them to their true geometric dimensions, as shown on the shop plans.~~

Ream or drill the full size of the field connection through templates after carefully locating the templates as to position and angle and firmly bolting them. Use exact duplicate templates used to ream matching members or the opposite faces of one member. Accurately locate templates for connections that duplicate so that like members are duplicates and require no matchmarking.

Accurately punch holes full-size, subpunch them, or subdrill them so that after assembling (before reaming), 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% of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller in diameter than the nominal size of the punched hole, the material will be rejected.

Ream or drill holes so that 85% of the holes in any contiguous group after being reamed or drilled show no offset greater than 1/32 inch between adjacent thicknesses of metal.

Provide in steel templates hardened steel bushings in holes accurately dimensioned from the center lines of the connection as inscribed on the template. Use the center lines to locate accurately the template from the milled or scribed ends of the members.

6. Shop Assembling. Completely shop assemble the entire structure, including the floor system. When the Contract Documents indicate "partial assembly," assemble continuous beams and plate girders in lengths of 3 or more abutting panels. ~~Except as modified below, assemble in the shop each main truss, arch member, continuous beam, tower (each face), bent plate girder, and rigid frame. Make milled ends of compression members in full bearing before starting reaming. Completely shop assemble an entire structure, including floor system, when indicated on the Plans or in the Special Provisions. When the Plans or Special Provisions indicate "partial assembly," assemble trusses, continuous beams, plate girders, and open spandrel arches in lengths of 3 or more abutting panels.~~ The assembled length must be at least 150 feet.

Clean metal surfaces in contact before assembling them. Assemble, pin well, and firmly draw together the parts of a member with bolts before beginning reaming. Make milled ends of compression members in full bearing before starting reaming. Take apart assembled pieces, if necessary, to remove burrs and shavings produced by reaming. Keep the members free of twists, bends, and other deformities.

To prepare to shop bolt material punched full-size, spear-ream the bolt holes, if necessary, to admit the bolts. Make the reamed holes no more than 1/16 inch larger than the nominal diameter of the bolts.

Secure end connection angles, stiffeners, and similar parts using shipping bolts to prevent damage in shipment and handling.

Furnish a camber diagram showing the camber for each main structural member.
Allow holes to drift during assembly only as needed to position the parts, and not enough to enlarge the holes or distort the metal. To enlarge holes to admit the bolts, ream them.
~~at each panel for each truss. Take the camber from actual measurement while the truss is assembled, or base it on calculated values when full assembly is not required.~~

~~Allow holes to drift during assembly only as needed to position the parts, and not enough to enlarge the holes or distort the metal. To enlarge holes to admit the bolts, ream them.~~

Match mark connecting parts assembled in the shop to allow for reaming holes in field connections. Furnish to the Engineer a diagram showing the marks.

7. Bolted Connections, High-Strength Bolts. Determine bolt lengths by adding the values given in Table 504-1 to the total thickness of connected material. These values compensate for thickness of nut, bolt point, and washers. Add 5/32 inch to the grip length per each additional flat washer. Adjust the total length to the next longer 1/4 inch increment up to a 5 inch length and to the next longer 1/2 inch increment for lengths over 5 inches.

Fit bolted parts solidly together when assembling them and do not separate them by gaskets or other interposed compressible material. Place hardened washers under the turned element.

**TABLE 504-1
BOLT LENGTH DETERMINATION**

Bolt Diameter (inches)	Added Length (inches)
1/2	11/16
5/8	7/8
3/4	1
7/8	1-1/8
1	1-1/4
1-1/8	1-1/2
1-1/4	1-5/8

Keep assembled joint surfaces, including those adjacent to washers, free of scale except tight mill scale. Clean off dirt, loose rust, burrs, and other defects that would prevent the parts from seating. Keep contact surfaces free of oil, paint, or lacquer.

When the outer face of the bolted parts has a slope of more than 1:20, use a smooth beveled washer in contact with the sloped surface.

Tighten fasteners to give at least the required minimum tension values shown in Table 504-2 when the joint is completed. Use bolts and nuts made by the same manufacturer in a connection.

**TABLE 504-2
REQUIRED BOLT TENSION**

Bolt Size (inches)	Required Minimum Tension (pounds)
3/4	28,400

7/8	39,250
1	51,500

To achieve the minimum tension values shown in Table 504-2, use direct load indicating washers that conform to ASTM F 959. Demonstrate the suitability of the device by testing a representative sample of at least three devices for each diameter and grade of fastener used in the structure. Test with a calibration device capable of indicating bolt tension. Include in the test assembly flat, hardened washers, if required in the actual connection, arranged as those in the actual connection to be tensioned. Demonstrate with the calibration test that the device indicates a tension at least 5% greater than that required by Table 504-2. Follow manufacturer's installation procedures when installing bolts in the calibration device and in all connections. Be careful to properly install flat, hardened washers when using load indicating devices with bolts installed in oversized or slotted holes and when using the load indicating devices under the turned element. The load indicating device will count as one washer for the purpose of determining bolt length.

Place the load indicating device under the bolt head and turn only the nut when tightening the bolt. The device must indicate full tensioning of the bolt when the opening reaches zero.

Install bolts in all holes of the connection and bring them to a snug tight condition. Then, tighten fasteners, progressing systematically from the most rigid part (usually near the center) of the connection to the free edges, or as directed. Keep previously tightened fasteners from relaxing. Multiple systematic tightening cycles may be required.

Do not reuse high-strength bolts. Remove previously fully tightened bolts that were loosened by tightening adjacent bolts. Replace them with new bolts, nuts, and load indicating devices.

8. Welding. Perform all welding and Nondestructive Examination (NDE) as specified or shown on the Plans. Conform to the most recent edition of the ~~to meet~~ ANSI/AASHTO/AWS Bridge Welding Code D1.5 when welding new steel bridge girders, beams, and stringers. Conform to the most recent edition of the Structural Welding Code AWS D1.1 when welding all other steel structures.

At least 30 days prior to welding, submit for approval a welding plan stamped and signed by a Certified Welding Inspector (CWI) responsible for the Quality Control (QC) and consisting of the following documents:

~~except meet AWS D1.1 when welding steel poles, piles, tubes, railing, grates, grate frames, deck expansion joints, and existing structures.~~

~~Prior to welding, submit for approval a welding plan consisting of the following:~~

- a. Quality Control personnel qualifications including CWI number.
- b. Welding Procedure Specifications (WPS) using forms in AWS D1.1, Sample Welding Forms.
- ~~b.~~
- c. Procedure Qualification Records (PQR) when applicable, using forms in AWS D1.1, Sample Welding Forms.
- d. Welder Performance Qualification Records (WPQR) using forms in AWS D1.1, Sample Welding Forms with documentation of current welder certification
- e. Sample daily inspection sheet
- f. Type and extent of NDE to be conducted, as required in the specifications

Using a CWI, pPerform all Quality Control inspection necessary to ensure the materials and workmanship meet the requirements of the contract documents.

Correct all deficiencies in materials and workmanship revealed by Quality Control and Quality Assurance inspections without additional compensation.

Furnish all completed Quality Control inspection documents to the Quality Assurance representative designated by the State.

~~Follow~~ Meet Charpy V-notch impact test requirements as shown on the Plans and according to Sections 715 and 716; except that the impact energy values for filler metals must not be less than that of the base metals to be joined, when tested at the same temperature as the base metal.

Do not weld or tack brackets, clips, shipping devices or other material not required by the Contract Documents to the permanent structure, unless shown on the working drawings and approved by the Engineer.

504-3.02 ERECTION.

1. General. Provide the falsework and all tools, machinery, and appliances, including driftpins and fitting-up bolts, needed to perform the work efficiently. Erect the structural steel, remove the temporary construction, and do the work to complete the structure, as required by the Contract ~~and according to these Plans and Specifications~~ Documents. Make temporary field welds to structural steel according to the procedures required by these Specifications. Steel with sharp kinks or bends will be rejected. ~~Heat straightening of A 514 or A 517 steel will be governed by special provision when used.~~

~~Install stud shear connectors on beams, stringers, girders, diaphragms, and other surfaces that may be used as walkways. Install stud shear connectors after erecting the structural steel and placing the concrete deck forms and before placing the deck reinforcing steel.~~

2. Handling and Storing Materials. Store material on skids above the ground. Keep it clean and properly drained. Place girders and beams upright and shore them. Adequately support long members, such as columns and chords, on skids to prevent injury from deflection.
3. Falsework. Use falsework according to Section 512.
4. Method and Equipment. Submit eight copies of an erection plan to the Engineer for approval. Submit the erection plan not less than thirty (30) days prior to erecting the structural steel. Do not erect structural steel without the written approval of the Engineer. Do not deviate from or change the approved plan without the written approval of the Engineer.

The erection plan must include, but is not limited to the following:

- a. Drawings indicating geometry, member sizes, material properties, foundations capacities, design assumptions, and other relevant information required to erect the structural steel.
- b. Support and lifting reactions for each stage of the erection procedure.
- c. Equipment type, size, capacity, position, work radius and other relevant information.
- d. Schedule, duration of each portion of work and other timing considerations.
- e. Prepared by a person proficient in structural design. Stamped with the seal of, dated by, and signed by a Professional Engineer registered in the State of Alaska.

If multiple segments will be connected and supported or lifted as a single member, the following additional information is required:

- f. Stress sheets for each state of the erection procedure.
- g. Deflection diagrams including camber effects and adjustments.
- h. Bolted field splice stress calculations
- i. Falsework, if required, details and supporting calculations in accordance with Section 512.

The erection plan shall conform to the requirements of the most recent edition of the AASHTO LRFD Bridge Design Specifications and the Contract Documents. Do not exceed the permissible stresses defined in the most recent edition of the AASHTO LRFD Bridge Design Specifications using a construction load factor of 1.25 for essentially static loads and 1.50 for dynamically applied loads. The Engineer will make the determination which loads shall be designated as static and dynamic loads.

Do not induce buckling or other instabilities at any time during shipping, handling or erection.

Submit changes needed to accommodate the erection plan to the Engineer for approval. Do not submit shop drawings until the Engineer has approved the erection plan.

Submit plans and calculations for the erection plan in one (1) complete submittal package. Partial or incomplete submittals will not be reviewed or considered. Partial or incomplete submittals will be rejected. No additional contract time will be permitted due to partial, incomplete, or inadequate submittals.

Do not deviate from the approved erection plan without the written permission of the Engineer.

Maintain responsibility for the safety of the method or equipment and complete the work according to the Contract Documents.

~~Before starting erection work, inform the Engineer of the proposed erection method and the proposed amount and character of the equipment.~~

~~Follow handling and erection procedures so as to avoid inducing critical buckling stresses in the girders.~~

~~Submit plans for approval showing the erection method. For trusses, except for simple span trusses supported throughout by falsework during erection, submit stress sheets showing the calculated stresses and deflections resulting from the planned erection sequence. Revise the truss as necessary to suit this erection method. Furnish stress sheets and deflection diagrams for any other unusual design or erection method.~~

~~The above methods and equipment are subject to the Engineer's approval. However, even with this approval, maintain responsibility for the safety of the method or equipment and complete the work according to the Plans and Specifications. Obtain approval before doing any work.~~

~~5. Straightening Bent Material. Straighten plates and angles or other shapes using methods not likely to fracture or injure the material. Heat the metal only when the Engineer permits. Do not heat to a higher temperature than what produces a "dark, cherry red" color.~~

~~After heating, cool the metal as slowly as possible. After straightening a bend or buckle, carefully inspect the metal surface for fractures.~~

5. Reserved.

6. Assembling Steel. Accurately assemble the parts as shown on the Plans and follow match-marks. Handle the material carefully to avoid bending, breaking, or otherwise damaging the parts. Do not hammer if doing so will injure or distort the members. Clean bearing surfaces and surfaces to be in permanent contact before assembling the members. ~~Unless erecting by the cantilever method, erect truss spans on blocking placed to give the trusses proper camber. Leave the blocking in place until the tension chord splices have been fully bolted and pinned and all other truss connections have been bolted. Wait to tighten the bolts in splices of butt joints of compression members and bolts in railing until the span has been swung. Fit up and tighten bolted joints as specified in Subsection 504-3.01.7.~~

~~7. Pin Connections. Furnish pilot and driving nuts for use in driving pins. Drive pins so that the members will take full bearing on them. Screw up tight and secure pin nuts as shown on the Plans.~~

7. Reserved.

8. Setting Shoes and Bearings. Place ~~shoes,~~ bearing plates, sole plates and elastomeric bearing pads ~~set directly on concrete surfaces~~ on properly finished bearing areas. Float the concrete surfaces on a level plane that varies no more than 1/16 inch from a straightedge placed in any direction across the area. Limit the variation of the finished surface to 1/8 inch from the elevation shown on the Plans. Set the ~~shoes, elastomeric bearing pads, and~~ bearing plates, sole plates and elastomeric bearing pads as shown on the Plans in exact position with full and even bearing.

Place under masonry plates grout that meets Subsection 701-2.03. Mix and place grout according to the manufacturer's written recommendations. Clean concrete areas that will contact the grout. Remove loose or foreign matter that would prevent the bond between the mortar and the concrete surfaces.

Tightly pack the grout under the masonry plates to provide full bearing. After placing, cover exposed surfaces of grout pads with a heavy thickness of burlap saturated with water for 3 days. Do not place a load on the grout until it has attained a compressive strength of 5000 psi.

Locate the anchor bolts ~~in relation to the slotted holes in the expansion shoes~~ to correspond with the temperature during erection. Adjust the nuts on anchor bolts at the expansion ends of spans to permit the span to move freely.

Apply epoxy adhesive, ~~meeting AASHTO M-235,~~ to the bottom surface of the elastomeric bearing pads before placing them. Do not move the pad until the epoxy has cured and full adhesion is achieved. Do not apply epoxy adhesive to elastomeric bearings used in PTFE bearing assemblies.

9. Attachment of Formwork. When approved, use 1-inch maximum diameter holes in steel girder webs for attaching formwork. Place holes 6 inches minimum clear distance from all horizontal or vertical welds and space them at least 4 feet center to center. Drill or subpunch and ream holes. They may be left open.

Include in the request enough detail of the formwork for determining the stresses that will be imposed on the girder.

504-3.03 PAINTING.

1. Preparing Metal Surfaces for Painting. Prepare metal surfaces according to Specification SSPC-SP 10, Near White Blast Cleaning to a profile depth of 1 to 3 mils. Use a profile comparator to ensure minimum profile depth. Do not reuse sand or flint abrasives.

Clean grit or shot of contamination before reusing it. Blow dust and grit from the surface with clean dry air. Remove weld spatter and round sharp edges to a smooth curve. To remove contamination, jet wash or scrub with a stiff brush and clear water or brush blast. Remove light rust with a steel brush or mechanical tool.

2. Schedule of Paint Coats for Metals. Unless otherwise specified, if structural steel will be exposed to weathering, shop-paint it at least 3 coats: prime coat, intermediate coat, and finish coat.

3. Painting Metal Surfaces.

- a. Time of Application. Apply 1 or more applications of prime coat. Apply the initial application within 4 hours after blast cleaning. Allow at least 30 minutes of drying time between primer applications. Before painting and after preparing the surface, remove any oil, grease, soil, dust, or foreign matter on the surface. If rusting occurs after the surface is prepared, clean the surface again.

Avoid contaminating cleaned surfaces with salts, acids, alkali, or other corrosive chemicals before applying the prime coat and between applications of the remaining coats of paint. Remove any contamination from the surface.

- b. Storage of Paint and Thinner. Store paint and thinner in a separate building or in a room that is well ventilated and free from excessive heat, sparks, flame, or direct sun rays. Keep paints susceptible to damage from freezing in a heated storage space when necessary.

Leave paint containers unopened until required for use. Use open containers first. Seal left-over, partial containers.

Do not use paint that has begun to polymerize, solidify, gel, or deteriorate.

- c. Mixing and Thinning. Mix paint thoroughly before use and agitate often during application.

Do not transfer paint mixed in the original container until all settled pigment is incorporated into the vehicle. Pouring off part of the vehicle temporarily to simplify mixing, is permitted.

Mix by mechanical methods, except use hand mixing for containers up to 5 gallons.

Do not use an air stream bubbling under the paint surface to mix paint or keep it in suspension. Remove and discard any skin that has formed in the container. Do not use the paint if the skin exceeds 2% of the paint volume.

When mixing paint, break up all lumps, completely disperse settled pigment, and create a uniform composition. If mixing by hand, pour off most of the vehicle into a clean container.

Lift the pigment in the paint from the bottom of the container using a broad, flat paddle. Break up lumps and thoroughly mix the pigment with the vehicle. Return the poured-off

vehicle to the paint by simultaneously stirring or pouring repeatedly from one container to another until the composition is uniform. Inspect the bottom of the container for unmixed pigment.

Wet tinting pastes or colors with a small amount of thinner, vehicle, or paint and thoroughly mix them. Add the thinned mixture to the large container of paint and mix until the color is uniform.

If paint does not have a limited pot life, or does not deteriorate on standing, mix it at any time before use. However, if it has settled, remix it immediately before use. Do not keep paint in spray pots, painters' buckets, etc., overnight. Gather it into a container and remix it before use.

When the engineer deems it necessary to obtain satisfactory application, add paint thinner according to the manufacturer's instructions.

- d. Application of Paint. Use the oldest of each kind of paint first. Apply paint by spraying. Use brushes, daubers, or sheepskins when no other method can properly apply paint in difficult access areas. Use dipping, roller coating, or flow coating only when authorized.

Blast clean all areas with mudcracking in the zinc-rich primer and then paint them with primer to the specified thickness.

After applying the prime coat, apply the intermediate and finish coats to exposed surfaces according to the manufacturer's recommendations.

Apply the intermediate coat in 2 applications. Apply the first application as a mist coat. Apply the second application after the mist coat has dried to a set-to-touch condition.

Apply the finish coat in 1 application.

Apply paint within the environmental limitations specified by the coating manufacturer. Do not apply paint when the temperature of the steel surface is less than 40 °F or more than 125 °F.

Do not apply paint in fog or mist, when it is raining or snowing, or when the relative humidity exceeds the manufacturer's recommendations. Do not apply paint to wet or damp surfaces. Do not apply paint on frosted or ice-coated surfaces.

With approval, apply paint in damp or cold weather, and only under the following conditions. Paint the steel under cover and protect and shelter it, or heat the surrounding air and the steel to a satisfactory temperature. Meet the above temperature and humidity conditions. Keep the steel under cover or protected until it is dry or until weather conditions permit its exposure.

Allow to dry any applied paint exposed to freezing, excess humidity, rain, snow, or condensation. Then, remove damaged areas of paint, prepare the surface again, and repaint it with the same kind as the undamaged areas.

Stripe paint before applying each coat of paint. Spot paint edges, corners, crevices, rivets, bolts, welds, and sharp edges before applying the full coat of paint on the steel. Extend striping for at least 1 inch from the edge. Let this stripe coat dry before applying the full coat, if possible. Otherwise, set-to-touch the stripe coat before applying the full coat. However, do not permit the stripe coat to dry long enough to allow the unprimed steel to rust.

Apply each coat of paint as a continuous film of uniform thickness, free of pores. Repaint any thin spots or areas missed in the application. Allow them to dry before applying the next coat.

Wait until each coat of paint is in the proper state of cure or dryness before applying the next coat.

Ensure a minimum dry film thickness of 3 mils and a maximum dry film thickness of 5 mils for each coat of paint. The dry film thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge. If any coat of paint is thinner than specified, obtain the minimum dry film thickness by applying additional coats of paint.

A Tooke gauge may be used to perform destructive testing of each coat's dry film thickness. Repair damaged areas.

- e. Brush Application. Brush paint areas inaccessible to a spray gun. Work paint into crevices and corners. Paint surfaces not accessible to brushes using daubers or sheepskins. Brush out runs or sags. Leave a minimum of brush marks in the applied paint.
- f. Spray Application of Paint. To apply paint by spraying, use equipment capable of properly atomizing the paint to be applied. Use equipment with pressure regulators and gauges and use air caps, nozzles, and needles recommended by the equipment manufacturer for the material being sprayed. Keep the equipment in satisfactory condition to permit proper paint application. In closed or recirculating paint spray systems, where gas is used under pressure over the liquid, use an inert gas, such as nitrogen.

Provide adequately sized traps or separators to remove oil and water from the compressed air. Drain them periodically during operations. Ensure that the air from the spray gun impinging against the surface shows no water or oil.

Keep paint ingredients properly mixed in the spray pots or containers while applying the paint. Use either continuous mechanical agitation or frequent intermittent agitation.

Adjust the pressure on the material in the pot and adjust the air pressure at the gun for optimum spraying effectiveness. Adjust the pressure on the material in the pot when changing the elevation of the gun above the pot. Keep the atomizing air pressure at the gun high enough to atomize the paint properly but not so high as to cause the paint to fog or the solvent to evaporate, or to cause loss by overspray.

Keep spray equipment clean to avoid depositing dirt, dried paint, and other foreign materials in the paint film. Remove any solvents left in the equipment before applying paint to the surface.

Apply paint in a uniform layer, overlapping at the edge of the spray pattern. During application, hold the gun perpendicular to the surface and at a distance that will deposit a wet layer of paint on the surface. Release the gun's trigger at the end of each stroke.

Apply coats free of runs, sags, and dry spray.

- g. Shop Painting. Perform shop painting after fabrication and before the surface is damaged from weather or other exposure.

Do not paint shop contact surfaces. Paint surfaces to be in contact after field erection.

Apply only a mist coat (0.5 to 0.8 mil dry film thickness) of inorganic zinc-rich primer, meeting SSPC Paint Specification No. 30, Weld-Through Inorganic Zinc Primer, Class 5, on the following surfaces:

1. High strength bolted connection contact surfaces
2. Top flange steel surfaces
3. Areas within 2 inches from the edges to be welded
4. Areas where the full 3 coats of paint will interfere with field assembly

Apply the full paint coats specified to steel surfaces that will contact wood.

Remove anti-weld spatter coatings before painting.

Before abrasive blasting, grind smooth all metal defects, fins, slivers, burrs, weld spatter, and sharp edges from shearing or similar operations, including flame hardened edges from cutting or burning. Grind flame hardened edges to a 1/16 inch minimum radius. Repair defects that become evident after abrasive blasting or prime coat application. Retexture the surface to match the blasted profile.

Copy erection marks and weight marks on areas that have been previously painted with the shop coat.

- h. Field Painting. If steel surfaces have not received the full paint coats, paint them as soon as possible after erection.

Touch up metal that has been shop coated with the same type of paint as the shop coat. Touch up by cleaning and painting field connections, welds, bolts and all damaged or defective paint and rusted areas.

If concreting or other operations damage any paint, clean the surface and repaint it. Remove concrete spatter and drippings before applying paint.

Protect wet paint against damage from dust or other detrimental foreign matter.

- i. Drying of Painted Metal. Allow the paint to dry before recoating or exposing it. Do not add a dryer to paint on the job unless the paint specification calls for one. Do not immerse painted metal until the paint has dried. Protect paint from rain, condensation, contamination, snow, and freezing until dry.

- j. Handling of Painted Steel. Do not handle painted steel until the paint has dried except for turning it for painting or stacking it for drying. Minimize damage to paint films from stacking steel members.

Remove paint that is damaged during handling and touch it up with the same number of coats and kinds of paint previously applied.

Wait until painted steel is dry before loading it for shipment.

Repair damaged galvanized coating per AASHTO M 36, Section 11. Use inorganic zinc rich primer meeting Subsection 708-2.01.

- k. System Durability and Certification. Have the coating manufacturer review the project and the proposed service environment and issue ~~you~~-written recommendations and instructions to properly prepare the surface, apply the coating, and achieve maximum durability on this project. [If the proposed system literature requires a higher degree of](#)

surface preparation/profile or greater film thickness than specified, follow the submittal requirements, with no additional compensation.

The coating manufacturer must certify that the system has been used successfully in the field for at least 2 years on similar structures in a similar environment as this project. Provide a list of at least three references of previous similar projects that used the proposed system, including the applicator and owner contacts.

Certify to the Department that the system was applied according to the manufacturer's recommendations and instructions. Enclose a copy of the recommendations and instructions with the certificate.

I. Final Inspection. Repair damaged coatings and remove marks, scuffs, stains, dirt and other visual imperfections in the coating surface to provide a uniform surface appearance. The Engineer will visually inspect the final surface for approval.

504-3.04 CLEANUP. Upon completion and before final acceptance of the structure, remove falsework and falsework piling down to 2 feet below the finished ground line.

504-4.01 METHOD OF MEASUREMENT. Section 109 and as follows:

Structural steel measured by weight, will include castings, forgings, alloy steels, steel plates, high-strength bolts and nuts, anchor bolts and nuts, stud shear connectors, shoes, rockers, rollers, pins and nuts, expansion dams, roadway drains and scuppers, weld metal, and structural shapes for expansion joints and pier protection.

The weight of the metal in the completed structure will be computed, based on the following:

1. Unit Weights, pounds per cubic foot:

Aluminum, cast or rolled	173
Bronze or copper alloy	536
Copper sheet	558
Iron, cast	445
Iron, malleable	470
Lead, sheet	707
Steel, cast or rolled, including alloy, copper bearing, and stainless	490
Zinc	450

2. Shapes, Plates, Railing and Flooring. By their nominal weights and dimensions as shown on the contract drawings, deducting for copes, cuts and open holes, exclusive of bolt holes. The weights of plates more than 36 inches wide will include an estimated overrun computed as one-half the "permissible variation in thickness and weight" as tabulated in ASTM A 6.

The weight of railing will be included as structural steel unless the bid schedule contains a pay item for bridge railing under Section 507.

The weight of steel grid flooring will be computed separately.

3. Castings. From the dimensions shown on the Plans, deducting for open holes. To this weight will be added 5% for fillets and overruns. Scale weights may be used for castings of small complex parts, since it would be difficult to compute their weight accurately.

4. Welds. From the following for shop and fillet welds:

<u>Size of weld (inches)</u>	<u>Pounds per linear foot</u>
1/4	0.20
5/16	0.25
3/8	0.35
1/2	0.55
5/8	0.80
3/4	1.10
7/8	1.50
1	2.00

The weight of other welds will be computed on the basis of the theoretical volume from dimensions of the welds, adding 50% to the weight to allow for overrun.

5. High-Strength Bolts. From the following for bolt heads and nuts for high-strength bolts:

<u>Bolt Diameter (inches)</u>	<u>Pounds per 100 Heads or Nuts</u>
5/8	15
3/4	25
7/8	37
1	50
1-1/8	75

6. Excluded Items. The weight of the following will not be measured: erection bolts, shop and field paint, galvanizing; boxes, crates, and other containers used for shipping; together with sills, struts, and rods used for supporting members during transportation; and bridge hardware connectors used for joining timber members.

504-5.01 BASIS OF PAYMENT. If no pay item is included in the bid schedule for structural steel, the quantities of metal drains, scuppers, conduits, ducts and structural shapes for expansion joints and pier protection measured as provided above, will be paid for as reinforcing steel under Section 503.

No additional payment will be made for increases in structural steel quantities due to your erection method.

Structural steel for precast or prestressed concrete bridges is subsidiary.

Payment will be made under:

Pay Item	Pay Unit
504(1) Structural Steel	Lump Sum
504(2) Structural Steel	Pound