505 Steel Reinforcement

505.1 Description

(1) This section describes furnishing and placing bar steel, high-strength bar steel or coated high-strength bar steel.

505.2 Materials

505.2.1 General

(1) Use deformed reinforcing bars unless the contract specifies otherwise.

(2) Unless the plans show otherwise or the special provisions specify otherwise, use the deformed type for all bar steel, all high-strength bar steel, and all coated high-strength bar steel reinforcement. If plain, round steel reinforcement is specified, conform to ASTM A675, grade 80.

(3) Use fabrication tolerances for straight and bent bars specified in Subsection 4.3, Tolerances, of the American Concrete Institute Committee 315, in the American Concrete Institute Detailing Manual.

(4) Unless the contract specifies otherwise, submit a manufacturer's certified report of test or analysis showing the reinforcement conforms to the specifications to the engineer before incorporating the reinforcement into the work.

505.2.2 Bar Steel Reinforcement

(1) Conform to AASHTO M31, type S or type W.

505.2.3 High-Strength Bar Steel Reinforcement

505.2.3 Revise to add test information for prestressed concrete girders.

(1) Conform to AASHTO M31, grade 60, type S or type W.

(2) For prestressed concrete girders, conform to AASHTO M31, type S or type W or ASTM A706, Grade 60.

505.2.4 Coated High-Strength Bar Steel Reinforcement

505.2.4.1 General

(1) Conform to AASHTO M31, grade 60, type S or type W. Ensure that the coating is applied in a CRSI certified epoxy coating plant. Bend bars that require bending before coating, unless the fabricator can bend the bar without damaging the coating.

(2) Do not weld epoxy-coated reinforcement except as the plans show.

505.2.4.2 Coating

(1) Coat reinforcement according to ASTM A775 with a fusion-bonded powder from the APL. Provide written certification from the resin manufacturer that the coating material is the same formulation and quality as submitted to the department for prequalification testing.

(2) Furnish a two-part epoxy resin conforming to ASTM A775 for field repairs and patching.

505.2.4.3 Damage Repair and Rejection

(1) Do not repair epoxy-coated high-strength bar steel reinforcement that does not conform to the requirements for coating thickness, continuity of coating, coating cure, or flexibility of coating. Replace the reinforcement or strip, reclean, and recoat epoxy-coated high-strength bar steel reinforcement with one or more of these defects.

(2) If using coated high-strength bar steel reinforcement in bridges, the department requires patching on circumferential areas with damaged coating, on sheared or cut ends, on end areas left bare during the coating process, and on any areas that the entire coating is removed.

(3) If using coated high-strength bar steel reinforcement in concrete pavement and miscellaneous concrete construction bid items in 415 or 416, the department requires patching on circumferential areas with damaged coating or removed coating. The department will not require patching on sawed ends, cut ends, coated damaged ends, or end areas left bare during the coating process.

(4) Patch with the material specified in 505.2.4.2(2) according to ASTM D3963 and manufacturer instructions.

(5) Complete required repairs before visible oxidation of the steel surface occurs.

(6) The engineer will reject bars having total damage greater than 2 percent of the total circumferential area of the bar length. Consider the entire loss of the coating at the specific area on the bar as total damage.

505.2.5 Welded Steel Wire Fabric for Concrete Reinforcement

(1) Use a fabric of the weight and design the plans show and conform to ASTM A1064.

505.2.6 Dowel Bars and Tie Bars

505.2.6.1 General

(1) For dowel bars and straight tie bars, there is no requirement for bend tests. Ensure that the bars are the specified diameter and length the plans show.

(2) The contractor need not coat or patch sawed ends, sheared ends, cut ends, ends left bare during the coating process, or ends with damaged coating.

(3) The contractor need not repair circumferential coating damage from shipping, handling, or installation, if the following conditions are met:

1. The damaged area is 1/4 inch square or smaller.
2. The total damaged area in any one-foot length does not exceed 2 percent of the circumferential area in that length.

(4) Repair areas of damaged circumferential coating larger than 1/4 inch square. Reject bars with total damage greater than 2 percent of the bar's circumferential area.

505.2.6.2 Dowel Bars

505.2.6.2.1 General

(1) Ensure that the bars are straight, round, smooth, and free from burrs or other deformations detrimental to the free movement of the bar in the concrete.

(2) Saw bars to the required length. For solid bars, the department will allow shearing if no damage occurs to the coating and shearing distortions do not exceed the following:

1. No distorted diameter is more than 0.04 inches greater than the true diameter.
2. No distortion extends more than 0.40 inches from the sheared end.

(3) Apply a surface treatment to loose dowels, or furnish manufacturer-treated bars in dowel bar baskets, capable of preventing bond between the epoxy-coated bars and the concrete. Apply field surface treatments when loading bars in the dowel bar magazine.

505.2.6.2.2 Solid Dowel Bars

(1) Furnish coated bars conforming to AASHTO M31 grade 40 or 60. Alternatively the contractor may furnish dowel bars conforming to AASHTO M227 grade 70-80. Coat in a plant certified by the Concrete Reinforcing Steel Institute with a thermosetting epoxy conforming to AASHTO M254, type B.

505.2.6.2.3 Tubular Dowel Bars

(1) Furnish welded steel tubular bars conforming to ASTM A513 fabricated from plain carbon steel with a minimum tensile yield strength of 60 ksi and sized as follows:

SOLID BAR SPECIFIED DIAMETER	MINIMUM REQUIRED OUTSIDE DIAMETER	MINIMUM BASE METAL WALL THICKNESS
1 1/4-inch	1 5/16 inches	0.120 inch

(2) Cap bar ends to prevent intrusion of concrete or other materials. Ensure that tubing is galvanized on the exterior and interior according to ASTM A653 with a G40 zinc coating and apply 7-13 mils of epoxy to the galvanized exterior according to AASHTO M254, Type B.

505.2.6.2.4 High Performance Dowel Bars

(1) As an alternate the contractor may furnish high performance dowel bars from the APL.

505.2.6.3 Tie Bars

(1) Furnish coated bars conforming to AASHTO M31 grade 40 or 60. Coat tie bars as specified in 505.2.4 for coated high-strength steel reinforcement. Ensure that the tie bars are the shape the plans show.

(2) Repair, with compatible coating material, the bend location of field-straightened coated tie bars.

505.3 Construction

505.3.1 General

(1) Store reinforcement above ground on platforms, skids, or other supports. Protect from mechanical injury and deterioration from exposure. Store epoxy-coated reinforcement on wooden cribbing and handle without dragging or dropping using padded or non-metallic slings.

(2) Cover epoxy-coated bars in storage, or placed in a bridge deck mat, with an opaque engineer-approved material to prevent cumulative exposure to sunlight for more than 2 months before being embedded in concrete. Include portions of partially embedded bars left exposed between construction stages.

(3) Mark reinforcement to facilitate inspection and checking. Ensure reinforcement is free from detrimental dirt, dust, paint, oil, or other foreign material when placed in the work. The engineer will not reject reinforcement with rust, seams, surface irregularities, or mill scale if the weight, dimensions, cross-sectional areas, and tensile properties of a hand wire-brushed test specimen conform to AASHTO M31.

(4) The contractor may field cut reinforcement by sawing, using abrasive cut-off blades, or flame cutting. Do not flame cut epoxy-coated reinforcement.

505.3.2 Bending

(1) Use bent bar reinforcement cold bent to the shapes the plans show, and unless the plans show otherwise or the engineer directs otherwise, conform to Recommended Hooks All Grades and Recommended Sizes for Stirrup and Tie Hooks, of the American Concrete Institute Committee 315. Ensure bending dimensions are out-to-out of the bar.

505.3.3 Splicing

505.3.3.1 General

(1) Furnish bar steel reinforcement in the full lengths the plans show. Except where the plans show, do not splice reinforcement without the engineer's written approval. The department will allow lapped splices, welded splices, mechanical couplers, or other connections the plans show or the engineer approves in writing. To the extent practicable, stagger splices in adjacent bars and locate splices as far as possible from the point of maximum tensile stress. The engineer will not allow splices at points that do not offer a minimum distance of 2 inches between the splice and the nearest adjacent bar, or design concrete cover the plans show at the splice location.

(2) Overlap the sheets of welded steel wire fabric to maintain uniform strength, and securely fasten at the ends and edges. Ensure the edge lap is at least one mesh wide.

505.3.3.2 Lapped Splices

(1) Ensure that lapped splices conform to plan requirements, are placed in contact with each other, and wired together to hold the bars in position for the full length of the splice.

505.3.3.3 Welded Splices

(1) The contractor may weld uncoated reinforcement only if the plans show welded splices or the engineer approves welded splices in writing. Do not splice epoxy-coated reinforcement by welding. Use welded butt splices conforming to the AWS D 1.4, Structural Welding Code - Reinforcing Steel. Use electrodes conforming to AWS D 1.5 and submit electrode acceptance reports according to AWS D 1.5.

(2) Use AWS D 1.4 certified welders to perform all welding. If welder certification tests are required, a department-approved independent testing agency will perform the testing. The engineer may require qualification tests according to AWS D 1.4.

(3) Test 4 percent of the total number of splices per each bar size, but not less than 4 splices. For both qualification samples and production splices, conform to AWS radiographic methods and provide test results prepared by an inspector qualified under AWS to perform radiographic interpretation.

505.3.3.4 Bar Couplers

505.3.3.4.1 General

(1) Provide threaded bar couplers unless the engineer approves an alternate coupler system in writing as allowed under 505.3.3.4.3. Ensure that the bar coupler or alternate coupler system material is capable of developing 125 percent of the specified yield strength of the bar being spliced.

(2) If splicing epoxy-coated bars, clean and coat couplers and exposed threads with epoxy. Couplers may be coated with epoxy before or after installation. Use epoxy that is compatible with the touchup epoxy used on coated reinforcing bars.

505.3.3.4.2 Threaded Bar Couplers

(1) Provide a manufacturer certified report of test or analysis, based on a minimum of 3 tests, showing the threaded bar coupler capacity.

505.3.3.4.3 Alternate Bar Coupler System

(1) Do not install alternate bar coupler systems before department proof testing and without the engineer's written approval. Provide 3 sample splices to the department for testing. Conform to the manufacturer's installation instructions and provide a copy of those instructions to the engineer.

505.3.4 Placing and Fastening

(1) Place steel reinforcement precisely in the position the plans show and hold firmly during the concrete placing and setting by using spacer strips, stays, recycled plastic chairs, metal chairs, or other

engineer-approved devices or supports. The contractor may use recycled plastic supports for a bottom layer of steel reinforcement which in turn supports upper layers on continuous bar chairs; but do not use individual plastic chairs to directly support upper layers. Unless the contract provides otherwise, use coated high-strength bar steel reinforcement in the top layer of reinforcement in the concrete deck.

(2) Make metal chairs from stainless steel, steel that is galvanized or epoxy coated after fabrication, or from uncoated steel with engineer-approved plastic tipped legs, or with at least 1/2 inch of the bottom of the legs hot dip galvanized or plastic-coated. Furnish epoxy-coated metal chairs or recycled plastic chairs to support coated high-strength bar steel reinforcement, subject to the plastic chair restriction stated above. The epoxy coating thickness must conform to ASTM A775.

(3) Use recycled plastic chairs manufactured from recycled plastic obtained from post consumer products. Ensure they are chemically inert in concrete and are molded in a shape that does not restrict concrete flow and consolidation around and under the chairs.

(4) For recycled plastic chairs conform to the following requirements within a temperature range of 20 F to 150 F:

PROPERTY	VALUE	ASTM TEST
Minimum shear strength	5000 psi	ASTM D732
Minimum compressive strength	10,000 psi	ASTM D695
Maximum water absorption	0.1 percent	ASTM D570

(5) Support bar steel reinforcement in the concrete decks and slab spans as follows:

1. For decks and slab spans, support bottom transverse bars with continuous bar chairs spaced 4 foot on centers or closer. Support the ends of the bars with a line of chairs near each deck or slab edge.
2. On decks less than 12 inches thick, support top longitudinal bars with continuous bar chairs spaced 4 foot on centers or closer. Provide a row of continuous bar chairs directly under each row of transverse bar splices.
3. On decks and slab spans 12 inches thick or thicker, support top transverse bars with individual supports spaced approximately 3 foot on centers or closer in both directions. Use either individual bar chairs setting on the form floor or bent reinforcement bars supported off the bottom mat. Support bars near the edge of the deck or slab with individual supports spaced 3 foot on centers or closer.
4. On decks with prestressed wide flange girders, place bar chairs with continuous bottom runners between the top and bottom longitudinal reinforcement layers at a maximum 4 foot spacing over the girder flange.

(6) The contractor may use precast concrete bricks or other engineer-approved bricks or blocking in structures to support reinforcement in footings or slabs placed on grade; however, the bricks or blocking must not contact the reinforcement over a distance greater than the depth of a standard concrete brick. Tie the upper layer of reinforcement for bridge decks securely to the girders or forms at a longitudinal spacing not greater than 8 feet. For decks of slab span bridges, the ties must have a transverse spacing not to exceed 8 feet, and for decks over girders, secure the ties to or next to each longitudinal line of girders.

(7) Tie the bars securely at intersections except if spacing is less than one foot in each direction, if alternate intersections are tied. Do not use tack welding to tie steel. Before placing any concrete in a unit or section, obtain the engineer's approval of the reinforcement placing and securing in that unit or section.

(8) Tie coated bars using a procedure, equipment, and materials that will not damage or cut the coating. Tie coated reinforcement with one of the following:

1. Ties made from an engineer-approved plastic or nonmetallic material.
2. Stainless steel wire.
3. Nylon, epoxy, or plastic-coated wire.

505.4 Measurement

(1) The department will measure the Bar Steel Reinforcement bid items by the pound acceptably completed. The department will compute the bar weight from the nominal weights for corresponding sizes for deformed bars in AASHTO M31. The department will not measure the following:

- Extra metal used if the contractor substitutes bars larger than those specified.
- Extra metal necessary for splices the plans do not show.
- Devices used to support or fasten the steel in its correct position.
- For new prestressed concrete girder bridges, extra bars used to accommodate girders with more or less camber than the plans show.

(2) The department will measure the Bar Couplers bid items as each individual coupler acceptably completed.

505.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
505.0100	Bar Steel Reinforcement Structures	LB
505.0400	Bar Steel Reinforcement HS Structures	LB
505.0600	Bar Steel Reinforcement HS Coated Structures	LB
505.0900-0919	Bar Couplers (size)	EACH

(2) Payment for the Bar Steel Reinforcement bid items is full compensation for providing, transporting, and placing reinforcement including supports. Where the plans specify bar couplers, the department will pay for the length of bars as detailed with no deduction or increase for installation of the coupler.

(3) Payment for Bar Steel Reinforcement HS Coated Structures includes coating, including epoxy-coated metal chair supports.

(4) Payment for the Bar Couplers bid items is full compensation for providing couplers, including bar steel that is part of the coupler and not detailed in the plan; for threading reinforcing bars; for installing and coating the splice; and for supplying and testing 3 couplers.