

## 711 - REINFORCING STEEL

### SECTION 711

#### REINFORCING STEEL

##### 711.1 DESCRIPTION

Place reinforcing steel as detailed in the Contract Documents.

##### BID ITEMS

Reinforcing Steel (\*) (\*\*)  
Reinforcing Steel (Repair) (\*) (\*\*) (Set Price)  
\*Grade  
\*\*Epoxy-Coated

##### UNITS

Pound  
Pound

##### 711.2 MATERIALS

Provide reinforcing steel, epoxy-coated reinforcing steel, epoxy patching material and reinforcing steel splices that comply with **DIVISION 1600**.

##### 711.3 CONSTRUCTION REQUIREMENTS

###### a. General.

(1) Storage and Protection. Store the reinforcing steel above ground on platforms or skids, and in a manner that will allow the Engineer to inspect the material for condition and verify the quantity. Identify the reinforcing steel with durable tags or markings.

Protect the reinforcing steel from dirt, detrimental scale, oil and other foreign substances. Do not place contaminated reinforcing steel into the work.

(2) Field Bending. Field bend the reinforcing steel, only as allowed in **DIVISION 1600**. Bend the reinforcing bars cold, using the proper tools. Do not heat reinforcing bars to facilitate bending. Unless shown in the Contract Documents, do not bend reinforcing bars partially embedded in concrete.

(3) Placing, Supporting and Fastening. Place, support and fasten reinforcing steel in the position shown in the Contract Documents according to the recommended industry practices set forth by the Concrete Reinforcing Steel Institute (CRSI), except as noted otherwise in the Contract Documents. See the Manual of Standard Practice published by CRSI (933 North Plum Grove Road, Schaumburg, IL 60173-4758) for recommended industry practices.

The Engineer must inspect and approve the reinforcement placed in any member, before concrete is placed.

Except for inserting tie bars into concrete pavement, and other special applications approved by the Engineer, do not lay or drive reinforcing steel into the concrete after the concrete is placed. Support all horizontal reinforcement with wire bar supports, plastic bar supports or supplementary bars. Use Class 1 Protection wire bar supports for epoxy-coated reinforcement, and Class 1, 2 or 3 Protection wire bar supports for other reinforcement. Do not use stones, concrete or wood to support the reinforcement. Use bar supports of proper height to maintain the clearance between the reinforcing and the formed surface (or top surface of deck slabs) to within a + $\frac{1}{4}$  inch, -0 inch of that indicated in the Contract Documents. If lengths of continuous bar supports are used, lap the end legs so they are locked or tied together. Do not use alternate methods of supporting the reinforcement without the approval from the Engineer.

The Contract Documents show the (maximum) bar support spacing. The Engineer will determine if the Contractor has sufficient supports to hold the reinforcement in position. Use wire ties to secure the reinforcing steel at bar intersections, and to tie the reinforcing to the supports and spacers. Tie reinforcing steel bars at all intersections around the perimeter of each mat of reinforcement. Tie the remainder of each mat of reinforcement at a minimum of 2 foot centers, or at every intersection, whichever is greater. Bend all wire ties in the top mat of reinforcement downward. Do not weld reinforcing steel to the bar supports or other reinforcement, unless shown in the Contract Documents.

Provide support for work platforms on the forms, not on the reinforcing steel.

(4) Reinforcing Bar Trusses. Place, support and secure bar trusses in proper position. Unless the bar trusses are designed and fabricated with outstanding legs that are in contact with the forms, support them on metal supports and spacers. If the weight of the trusses causes the supporting legs of trusses to indent into the forms, use bar supports as auxiliary support for the truss legs.

## 711 - REINFORCING STEEL

(5) Mesh Reinforcement for Structures. Provide mesh reinforcement of the size and spacing shown in the Contract Documents. Lap the sheets of mesh as indicated in the Contract Documents. The method of placing the mesh and securing it in proper position must be approved by the Engineer.

(6) Box Culvert Reinforcing. Use Grade 60 reinforcing steel for road culverts and reinforced concrete box bridges, unless otherwise noted in the Contract Documents.

### **b. Epoxy-coated Reinforcement.**

(1) Perform all fabrication and jobsite handling of epoxy-coated reinforcing bars, dowel bars and tie bars for pavement according to ASTM D 3963/D 3963M, "Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars". For epoxy-coated steel wire and welded wire fabric, follow ASTM A 884/A 884M, "Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement". Consider the appendix to ASTM A 884/A 884M (that is identified as nonmandatory information) to be mandatory for this specification. Coating applicators and fabricators must comply with all aspects of above referenced documents.

(2) Storage, Handling and Placement at the Jobsite. When handling coated steel reinforcement, avoid bundle-to-bundle or piece-to-piece abrasion. Do not drop or drag epoxy-coated reinforcement.

Protect contact areas on equipment used for handling coated steel reinforcement. Use padded or non-metallic slings and padded straps when unloading.

Off-load coated steel reinforcement as close as possible to its point of placement, or within reach of the crane so that the material can be hoisted to the area of placement with minimum re-handling.

Store coated steel off the ground on protective cribbing, with timbers placed between bundles if stacking is necessary. Space the supports sufficiently close to prevent sags in the bundles.

Store coated and uncoated steel reinforcement separately.

Minimize long term storage. Due to the uncertainty of how long epoxy-coated steel will remain on the job site before incorporation in concrete, cover it with opaque material immediately on delivery, unless it is placed as soon as it arrives. For stacked material, drape the protective cover around the perimeter of the stack. Secure the covering adequately allowing for air circulation around the coated reinforcement to prevent condensation under the covering.

Tie coated reinforcement with tie wire coated with epoxy, plastic, nylon or other non-conductive material that shall not damage or cut the coating.

Use supports coated with, or made of, a dielectric material compatible with concrete.

After placing, minimize walking on coated steel reinforcement. Plan the placement of mobile equipment to avoid damage to the coated steel. If the epoxy-coated reinforcing steel placed in a structure or on the roadway will not be incorporated in concrete within 30 days, cover the epoxy-coated reinforcing steel with opaque material until the concrete is placed.

For all epoxy-coated steel reinforcement, except dowel bars and tie bars for pavement, use vibrators with heads of rubber or other resilient material for concrete consolidation. Do not use bare steel-headed vibrators. Rubber covers, securely fastened over steel heads will be acceptable.

(3) Repair of Damaged Epoxy. If the extent of the damage to the epoxy coating, by any cause, is a maximum of 1% of the surface area in any 1 foot length, remove all rust from damaged areas, and repair according to patching material manufacturer's instructions.

Reject the damaged material if the extent of the coating damage exceeds 1% of the surface area of the coated steel reinforcement in any 1 foot length.

**c. Splicing.** If it is necessary to splice reinforcement at points other than those shown in the Contract Documents, before ordering the reinforcing steel, submit drawings showing the location of each splice to the Engineer for approval. Avoid splices at points of maximum stress. Where possible, stagger the splices, and design them to develop the strength of the bar without exceeding the allowable unit bond stress. Lap bars according to the details shown in the Contract Documents. Do not use lapped splices for bar sizes larger than No. 11 bar. Splicing of reinforcing steel by welding is permitted only when shown in the Contract Documents. Where the bar size exceeds No. 11 bar, use welded splices or other positive connections with the approval of the Engineer. Make welds of direct butt splices, according to the American Welding Society publication, ANSI/AWS D1.4 "Structural Welding Code-Reinforcing Steel". A welder certified by the American Welding Society is required.

**d. Mechanical or Thermomechanical Splices.** At locations shown in the Contract Documents, splice reinforcing bars, using a mechanical or thermomechanical splicing process, as specified herein using the designated type of splice. Provide splicing devices and systems prequalified as required in **DIVISION 1600**.

## 711 - REINFORCING STEEL

### (1) Splice Types.

(a) Thermomechanical splices are made using a process whereby molten filler metal is introduced into an annular space around the bars created by a high strength steel sleeve of larger diameter than the bars. The Engineer will require operator prequalification.

(b) For mechanical splices, use any mechanical device or system complying with the physical requirements in **DIVISION 1600**.

(2) Prequalification of Operators. Before commencing production splicing, operator qualification is required for all splicing systems. The individual that will perform the production splicing must prepare the test specimen. If more than one person will perform the splicing, make a separate set of specimens by each individual.

For qualification, the Contractor's operator must make a set of 3 test splices of the predominant bar size and orientation in the project. The Engineer will observe the Contractor's operator make the splices using manufacturer's standard jigs, clamps, ignition devices and other required accessories. Identify each operator by attaching their name to the test splice. Forward the test splices to the MRC (where they will be tension tested to destruction). The MRC will issue reports of the tests to the operator, Contractor and Field Engineer.

If the splice is attached to one of the bars in a fabricator's shop and the other end of the splice is performed in the field, or mechanical couplers are attached to bars for easy assembly in the field and the system is one identified as requiring operator prequalification, the fabricator must prepare test specimens as outlined above and forward them to the MRC for testing before shipping material to the project. In lieu of observation by the Engineer, the fabricator must provide a notarized certification of the operator's identity along with the specimens.

The Engineer will waive the operator prequalification requirement if the operator provides a copy of a satisfactory KDOT test report, dated within 2 years of the current date that was issued in conjunction with the operator's qualification testing for the same splicing system on previous projects, as outlined in **subsection 711.3d.(1)(a) or (b)**. Fabricators must provide a certified copy of such operator qualification to the Engineer along with the shipping documents.

(3) Construction Requirements. Prepare the ends of bars for splicing in compliance with the splice manufacturer's recommendations.

The Engineer will visually examine mechanical or thermal splices. Remove and replace all splices having visible defects. Do not encase any splice in concrete until approved by the Engineer.

For those splicing systems requiring operator qualification, make 1 tension test specimen splice to represent each lot of bars spliced in the field. Unless shown otherwise in the Contract Documents, a lot consists of all bars in a days run for all splices. When possible, take test specimens alternatively between the horizontal and vertical positions. Make specimens by the same operator and under the same conditions as the splices they represent.

If the splicing systems require the entire splice be prepared in a fabricator's shop for later assembly in the field, and the field assembly requires operator prequalification, each shipment to the project is considered a separate lot. One specimen is taken from each lot.

For those projects requiring daily sampling, deliver the specimens to the MRC (where they will be tension tested to destruction) as soon as possible. The specimens must develop a minimum of 125% of the specified yield strength of the bar.

To expedite testing for projects remote from the MRC, the Contractor may hire a private laboratory approved by the Engineer of Tests to perform the tests and issue reports. All costs of such testing and reports are borne by the Contractor. Provide 1 copy of all reports issued under such an arrangement to the Field Engineer, and forward 1 copy to the Engineer of Tests.

If any single test specimen fails to meet the strength requirements, cut 2 production splices from the lot represented by the specimen and tension test them. If both re-tests meet strength requirements, all splices in the lot are accepted. If 1 or both re-tests fail to meet the requirements, all splices in the lot are rejected. All costs of removal and re-splicing are borne by the Contractor.

Protect any concrete forms which may be close to thermal bar splices from the heat generated by the splicing operation by overlaying the affected surface of the form with fire protection sheeting, or by other means approved by the Engineer.

### 711.4 MEASUREMENT AND PAYMENT

The Engineer will measure the reinforcing steel by the pound, based on the theoretical number of pounds shown in the Contract Documents or placed as ordered in writing by the Engineer. No allowance is made for the clips, wire or other fastening devices for holding the steel in place. The Engineer will verify the quantities of

## 711 - REINFORCING STEEL

materials provided and placed based on the calculated weight of the reinforcing steel placed according to these specifications. Additions and deletions from plan quantity will be computed using **TABLE 711-1**.

<b>TABLE 711-1: BAR SIZE WEIGHTS</b>		
<b>Bar Size (US Customary)</b>	<b>Bar Size (SI)</b>	<b>Weight (Pounds / Lin.Ft.)</b>
#3 or 3/8"	9 or 10*	0.376
#4	12 or 13	0.668
#5	15 or 16	1.043
#6	19 or 20	1.502
#7	22	2.044
#8	25	2.670
#9	29 or 30	3.400
#10	32	4.303
#11	35 or 36	5.313
#14	43 or 45	7.650
#18	55 or 57	13.600

\*Consult with KDOT's Bureau of Design, State Bridge Office, to determine the correct conversion of the 10mm bars.

No allowance is made for the weight of weld metal used in the fabrication of bar trusses. No separate compensation is allowed for the cost of making and providing splices and test splices.

If during the course of structure repair, deteriorated existing reinforcing steel is encountered, and the Engineer requires it replaced, provide and place new reinforcing steel according to specification. Reinforcing steel used for repair is measured as provided above. No measurement is made for replacement of existing reinforcing steel damaged through negligence of the Contractor. No measurement is made for material in approved splices made for the Contractor's convenience.

Payment for "Reinforcing Steel" at the contract unit price and "Reinforcing Steel (Repair) (Set Price)" at the contract set unit price is full compensation for the specified work.