

705 - STRUCTURAL STEEL FABRICATION

SECTION 705

STRUCTURAL STEEL FABRICATION

705.1 DESCRIPTION

Fabricate the structural steel according to the Contract Documents.

705.2 MATERIALS

a. General. Provide materials that comply with the applicable requirements.

Castings	DIVISION 1600
Structural Steel	DIVISION 1600
Welded Stud Shear Connectors	DIVISION 1600
Fasteners	DIVISION 1600

When weathering steel is allowed or specified in the Contract Documents: ASTM A709 Grade 50W may be substituted for ASTM A709 Grade 36 or Grade 50, and AASHTO M270 Grade 50WT2 may be substituted for AASHTO M270 Grade 50T2. When substituting weathering steel for the structural steel shown in the Contract Documents, use the same size plate or rolled member. Do not use weathering steel in rocker bearing devices (or any component with finished surfaces), expansion devices or expansion device armoring.

b. Preliminary Shop Requirements.

(1) Point of Fabrication. Within 10 business days after signing the contract, notify the State Bridge Engineer and the Bureau Chief of Materials and Research in writing of the firm (name and location) that will fabricate the structure. Produce and fabricate all structural steel within the Continental United States (see **subsection 106.1c.**). Use fabricators of bridge beams and girders that are certified by the American Institute of Steel Construction in the appropriate category for the type of work being performed.

(2) Shop Drawings. The Contractor or fabricator must submit shop drawings of both structural steel and castings according to **subsection 105.10**. Do not perform any fabrication until the approved shop drawings are in the hands of the Inspector and fabricator, and the Engineer has authorized fabrication. Any purchase of materials before fabrication authorization is at the Contractor’s risk.

Changes on approved shop drawings or contract plans are subject to the approval of the Engineer. Notify the Engineer with a record of such changes. Submit revised sheets of the same size as the shop drawings originally submitted.

Show approved welding procedure numbers in the tail of weld symbols on submitted shop drawings. Submit 2 copies of each procedure requiring approval to the Bureau of Materials and Research. All weld procedures referenced in a set of shop drawings must be approved before the shop drawings can be approved.

Provide a diagram on the shop detail plans for each span giving sufficient dimensions for accurate fabrication and inspection of the structure. These dimensions must include, but are not limited to:

- Bearing-to-bearing lengths; and
- Vertical and horizontal curvature offsets at bearing points and splices. Use the bottom of the web or the top of the bottom flange at the centerline of the web as the reference point.

The Contractor is responsible for the correctness of the shop fit-up and field connections, even though the shop drawings have been approved by the Engineer. See **subsection 105.10e**.

(3) Notice of Beginning of Work. In order to provide inspection, notify the Engineer before beginning work in the shop. Give a minimum of 24 hours notice before beginning work in shops in the State of Kansas, and give a minimum of 7 calendar days notice before beginning work in shops in the contiguous United States.

(4) Material Acceptance. Submit to the Bureau Chief of Materials and Research 1 copy of each mill test report for each heat number to be used before the layout, and use such steel in the fabrication of the structure.

Submit a fabricator’s guarantee indicating that the attached certified mill test reports pertain to all heat numbers used in the structure, and all material complies with the Contract Documents. Include the following in the guarantee:

- fabricator’s name;

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- KDOT project number;
- bridge or station number;
- fabricator's purchase order number;
- list heat numbers;
- size and shape of pieces;
- number of pieces to be used for each size of each heat; and
- steel manufacturer's name and the ASTM or AASHTO designation for the steel that is required in the Contract Documents.

The guarantee must include the notarized signature of an official of the company who is authorized to legally bind the statement on the company's behalf.

All structural steel shall comply with the ASTM A 6 quality requirements until released for shipment. Repair welding shall comply with the requirements of AASHTO/AWS D1.5 (2002), "Bridge Welding Code" with the exceptions and additions noted in this section.

The term "mill" means any rolling mill or foundry where material for the work is manufactured. When any ASTM or AASHTO steel is specified in the Contract Documents, the mill must certify that the material complies with the specified chemical and physical requirements. When the letter "T" or "F" and a temperature zone number follow the grade designation of an AASHTO or ASTM steel, the mill test report must include Charpy V-notch test results. The fabricator must obtain written permission from KDOT to substitute a grade of steel that is not indicated in the Contract Documents for one that is shown in the Contract Documents.

(5) Facilities for Inspection and Testing. During all hours of operation allow the Engineer free access to all parts of the work and the shop where fabrication is performed.

Provide an enclosed office area for the exclusive use of the Engineer at the location of fabrication. The area must satisfy the requirements of a Field Office (Special) in **SECTION 803**, except as modified below:

- Minimum floor area = 120 square feet;
- Single workbench or table - 30 inch by 8 feet (minimum dimensions);
- Desk - 30 inch by 5 feet, with drawers;
- Swivel desk chair with arm rests;
- Waste paper basket; and
- Storage/Filing cabinet with lock and key

When directed by the Engineer, promptly repair or replace any damaged or non-functioning items. Provide parking near the office with direct accessibility to the office and shop.

(6) Test Specimens. When directed by the Engineer, prepare 4 inch by 24 inch test specimens of the base metal. Orient the specimen so the direction of rolling is according to the latest edition of ASTM A 6. Provide "all-weld-metal" tension specimens and specimens for other weld tests as directed by the Engineer. Preparation and possible shipment of specimens are subsidiary to the fabrication of the structure.

(7) Heat Curving Procedure. Girders and rolled beams may be heat curved by either the continuous or "V" heating methods. Before starting any fabrication and before submittal of shop drawings for the structural steel, the Contractor or fabricator may request permission to heat-curve rolled beams in the shop or to heat-curve welded plate girders in lieu of flame cutting flanges to the desired horizontal curvature. Submit the request and proposed shop procedure to the Engineer for approval. The submittal must indicate the type of heating, heating temperature, position for heating, sequence of operations and the values to be used to compensate for possible loss of camber of heat-curved girders in service. The proposed procedure must comply with the latest editions of AASHTO/AWS D1.5, "Bridge Welding Code", AASHTO's "Standard Specifications for Highway Bridges" and AASHTO's "LRFD Bridge Construction Specifications".

c. Handling. Conduct the loading, transporting, unloading and storing of structural steel to keep the metal clean, above ground and free from injury. Use protective devices or softeners to safeguard plate edges.

Store structural steel, either plain or fabricated, above the ground on platforms, skids or other supports, and keep free from corrosion, dirt, grease and other foreign matter. Store girders and beams upright with sufficient support to prevent warping or change in design camber.

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d. Shop Fabrication.

(1) Steel Identification. All pieces of all grades of steel used in fabrication of main members, including webs, flanges, bearing stiffeners, bearing devices, splice plates and any cross member carrying stringers and their connection plates, must bear the heat number assigned by the rolling mill. Preserve the heat number until the Engineer advises the fabricator that the unit is acceptable for cleaning and painting. Identify the grade as specified in ASTM A 6.

(2) Straightening Material. All mill material must be straight before being laid out for work. If straightening is required, do not injure the metal. Heat straightening must comply with the latest versions of AASHTO/AWS D1.5, "Bridge Welding Code"; AASHTO's "Standard Specifications for Highway Bridges"; AASHTO's "LRFD Bridge Construction Specifications"; and the FHWA report, "Heat-Straightening Repairs of Damaged Steel Bridges". Submit the proposed heat straightening procedure to the Engineer for approval. Sharp kinks and bends are cause for rejection of the material. Mill material must not exceed dimensional tolerances outlined in the latest edition of ASTM A 6.

(3) Welding and Gas Cutting. Perform welding and gas cutting of structural steel according to the applicable requirements of the AASHTO/AWS D1.5 (2002), "Bridge Welding Code" with the exceptions and additions noted in this specification.

Perform welding and gas cutting on steel bearings, drainage systems, finger plate or modular expansion devices, handrail, bridge rail, sign structures and other tubular structures according to the applicable requirements of AWS D1.1 "Structural Welding Code", latest edition. At the option of the Engineer, steel bearing device inspection will require either 1 piece in 10, or fraction thereof, be tested 100%, or 10% of each piece will be tested using liquid penetrant or magnetic particle. The welding of dissimilar metals is not prequalified.

(4) Finish. Neatly finish all work. Carefully and accurately shear and clip. Fabricate finished members true to line and detailed dimension, and free from twists, bends, open joints or other defects.

(5) Pins and Rollers. Accurately turn pins and rollers to the dimensions shown in the Contract Documents and keep them straight, smooth and free from flaws. Produce the final surface by a finishing cut.

Forge and anneal pins and rollers larger than 7 inches in diameter, unless shown otherwise in the Contract Documents.

In addition, for pins larger than 9 inches in diameter, after the forging has been allowed to cool to a temperature below the critical range, under normal conditions, and before being annealed, bore a hole a minimum of 2 inches in diameter full length along the axis.

(6) Boring Pin Holes. 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, unless otherwise specified. Produce the final surface by a finishing cut.

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

(7) Pin Clearances. Do not exceed the diameter of the pin hole by that of the pin more than 1/50 inch for pins 5 inches or less in diameter, or 1/32 inch for pins greater than 5 inches in diameter.

(8) Threads. Closely match threads of bolts to the nut threads. Threads must be ANSI Unified Coarse Series (UNC), except make pin ends of diameters greater than 1 1/2 inches, with 6 threads per inch.

(9) Pilot and Driving Nuts. Provide 2 pilot nuts and 2 driving nuts for each size of pin, unless otherwise specified.

(10) Fit of Stiffeners. Mill, grind or machine cut bearing stiffeners intended as supports for concentrated loads to secure full bearing against the flange. Use intermediate stiffeners with a tight fit and uniform distance between the flange plates and the ends of the stiffeners, unless shown otherwise in the Contract Documents.

(11) Facing of Bearing Surfaces. Plane or heat straighten the top and bottom surfaces of steel slabs, base plates, cap plates of columns and pedestals to have full contact when assembled to the main members. Mill parts of members in contact with these items to true surfaces and correct bevels, after the main sections of these members and the end connection angles have been fully welded or bolted.

For bearings to be welded to beams and girders, a minimum of 75% of the area shall be in contact with the flanges. Do not exceed a 1/32 inch gap between bearings and flanges. Plane or heat straighten bearing devices as needed. Plane cast pedestals on surfaces in contact with steel.

Unless shown otherwise in the Contract Documents, adhere to the following surface roughness requirements as defined in ANSI B46.1, Surface Texture, Roughness, Waviness, and Lay, Part 1 for the surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or concrete. Surfaces will be evaluated by visual or actual comparison with roughness comparison specimens.

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Sliding Bearings	ANSI	125 Microinches
Bridge Rollers and Rockers	ANSI	250 Microinches
Pins and Pin Holes	ANSI	125 Microinches
Steel Slabs	ANSI	2000 Microinches
Heavy Plates in Contact with Shoes to be Welded	ANSI	1000 Microinches
Milled Ends of Compression Members, Milled or Ground Ends of stiffeners and Fillers	ANSI	500 Microinches

(12) Welded Stud Shear Connectors. Apply welded stud shear connectors to the designated structural members during shop fabrication.

If the circumstances warrant, and if the Engineer approves the Contractor's procedures, welded stud shear connectors may be field applied. Approval is based on demonstrating to the Engineer's satisfaction, that the Contractor can:

- remove any shop applied coating removed from the top flange without damaging the structural member;
- weld the stud shear connectors to the structural member; and
- blast clean and prime coat the top flange and stud shear connectors.

(13) Field Connections. When field bolts are required, adjust the girders or beams so the maximum final clearance between abutting ends of the web plates or flange plates is $\frac{1}{4}$ inch. Attach the web splice plates using sub-drilled holes in each corner of the splice plate. Secure them with bolts and drill the remaining holes full diameter from the solid. Add additional bolts and full size pins as the holes are drilled to secure the splice plates to the web. Clamp the flange splice plates and bars into position, and drill the bolt holes full diameter from the solid.

Add additional bolts as the holes are drilled to secure the splice plates to the flanges. Other methods of preparing flange and web field splices may be utilized with written approval of the Engineer. Fill plate thicknesses shown in the Contract Documents are based on nominal ASTM A 6 shape dimensions. Revise plan fill plate thicknesses as necessary to account for as-rolled variations in flange and web thickness or overall beam depth. Minimum fill plate thickness is $\frac{1}{8}$ inch or as required so that surfaces to be in contact shall be offset a maximum of $\frac{1}{16}$ inch.

Either punch or drill all holes for bolts except in flanges and webs of beams, girders or stringers. Material forming parts of a member composed of a maximum of 5 thicknesses of metal may be punched $\frac{1}{16}$ inch larger than the nominal diameter of the bolts whenever the total thickness of the material is a maximum of $\frac{3}{4}$ inch for structural steel, $\frac{5}{8}$ inch for high-strength steel or $\frac{1}{2}$ inch for quenched and tempered alloy steel.

If there are more than 5 thicknesses, or if the material is thicker than $\frac{3}{4}$ inch for structural steel, $\frac{5}{8}$ inch for high-strength steel, or $\frac{1}{2}$ inch for quenched and tempered alloy steel, either sub-drill and ream or drill all holes full size.

The diameter of the die for punched holes may not exceed the diameter of the punch more than $\frac{1}{16}$ inch. If any holes must be enlarged to admit the bolts, ream such holes. Clean cut holes leaving no torn or ragged edges. Poor matching of holes will be cause for rejection.

(14) Shop Assembly for Final Inspection. Unless otherwise provided both in writing and shown on the approved shop drawings, assemble, securely support, adjust and maintain to proper line, grade, camber and suitable clearances all welded plate girders, rolled wide flange beams, trapezoidal plate "tub" sections and other sections of main members.

After the assembly is completely set up, the fabricator's quality control personnel must check blocking, sweep and bearing-to-bearing measurements prior to any checking by the Engineer.

Reference "affect" measurements to the bottom of the web or the top face of the bottom flange at or near the centerline of the web.

Drill all splice holes and adequately bolt or pin splice plates in place before the assembly is checked by the Engineer. Use a minimum of 6 drift pins, full size bolts or a combination of both pins and full size bolts at each flange and web splice for girders and rolled beams.

In making the final assembly, if re-cutting is necessary to form a uniform width opening across the joint, finish the butt joint by precision flame cutting or flame cutting and grinding to produce the same smoothness as the precision cut. Mechanical chipping is prohibited.

Fit, drill or ream and bolt into place erection angles, while the beams or girders are in the fit-up position so that standard drift pins can be driven through any combination of holes, and the beams or girders can be pulled to correct spacing for field welding when erected at the bridge location.

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The types of assemblies are as follows:

- Type "A" Assembly (For structures with horizontal curvature transitions, super elevation or ramp tie-ins) requires a minimum of 2 spans (bearing to bearing) laid-out full bridge width, with separators attached at pier points (minimum). When released, carry the pier pieces back for the next additions. Include the girder or beam expansion devices in position in the assembly, if attached directly to the structural steel. Requests for a lesser width of the assembly for lack of shop space must be approved in writing by the Bureau of Materials & Research. If the request is approved, the Contractor may be back charged for excessive shop inspection trips and expenses.
- Type "B" Assembly requires a minimum of 2 lines and 2 spans (bearing to bearing) in each line laid-out to correct line with webs vertical or horizontal. When released, carry 1 pier piece per line back for the next additions.
- Type "C" Assembly (for long span, deep girders) requires a minimum of 2 spans (bearing to bearing) laid-out to correct alignment with webs horizontal or vertical. The spans may all be from different lines. When released, carry 1 pier piece per line back for the next additions.

All assemblies are Type "B" unless stated otherwise in the Contract Documents. All desired changes to the requirements of the type of assembly for a particular structure must be approved in writing before submitting the shop drawings for approval. Submit requests for assembly changes to the Bureau of Materials and Research. Without written approval from the Bureau of Materials and Research, the fabricator must set up assemblies according to the original requirements in the Contract Documents, even if approved shop drawings show changes to the type of assembly.

Use numbered tapes calibrated by the National Institute of Standards and Technology (NIST) or tapes calibrated from a certified master tape in order to check assemblies for bridges with spans over 100 feet. Provide a copy of the certification papers, calibration charts, and tape identification numbers before the first assembly is set up. In addition, submit to the Engineer for approval, procedures for calibrating tapes and the shop's practices when using calibrated tapes. This approval is required prior to initial assembly set-up. Calibrate measuring tapes for a minimum tension of 5 lbs. Prior to calibrating or measuring, allow time for the tapes to reach uniform ambient temperatures so that temperature corrections are not required. Replace or repair, and re-certify or re-calibrate damaged tapes. Re-certify master and re-calibrate NIST tapes every 5 years, or as directed by the Engineer.

(15) Matchmarking. Matchmark all butt joints (girders, expansion devices, end separators under expansion devices or other specialties to be field assembled and welded or bolted into the final unit) while shop assembled, in the manner indicated as "Typical Matchmark", and shown on the approved shop drawings. Use a coordinate system of capital letter and numbers as follows:

- Mark each line of girders with a capital letter. Looking upstream, mark the outside line, left of centerline, with the first letter of a series. Mark the girders in the next line to the right with a second letter of the series, etc., until all lines have been marked; and
- Mark the field splices (points of contraflexure) with numbers. Place the lowest number on the splices nearest abutment number 1 and the highest number on the splices nearest abutment number 2. Number the splices consecutively from abutment number 1 to abutment number 2. Place these on each of the girder ends that comprise the splice and within 3 feet of the field splices in the center of the web. Use low stress steel die marks placed before shop blasting and painting. Orient letters and numbers so they are upright when the top flange is up.

Matchmark essential special fit-ups discovered in shop production. Provide a corrected set of shop details and erection drawings showing these special fit-ups.

Do not matchmark the exposed surface of "Weathering" Steels with paint, crayon or any other type of material which will impair the weathering process of the steel.

(16) Shop Painting. Prepare the structural steel surfaces and shop paint the prepared surfaces according to **SECTION 714**.

(17) Rejection. Do not release fabricated elements for shipment from the fabrication shop without approval of the Engineer. Repair or replace rejected items as directed by the Engineer.

(18) High Performance Steel (HPS). Fabricate Grade HPS 70W members according to this subsection and AASHTO's "Guide Specification for Highway Bridge Fabrication with HPS 70W Steel", second addition.

(19) Shop Connections by Bolting. Fasten members according to **SECTION 712**.

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e. Supplemental Requirements to the Welding Code. The section and paragraph references cited in the paragraphs below are to AASHTO/AWS D1.5 (2002).

SECTION 1. GENERAL PROVISIONS.

Delete paragraph 1.3.2 and add the following:

1.3.2 Electroslag or electrogas welding shall not be used.

Add 2 new paragraphs as follows:

1.12 EQUIPMENT CHECK: Each DC generator shall have a service check by an NEWA member, a commercial electrical equipment company or by the fabricating plant's electrical maintenance engineer once each year. A service certificate shall be issued with each equipment check and shall be available for inspection by the Engineer.

1.13 TEMPORARY WELDING AND TACKING: The attachment of temporary fabrication, erection and construction items to main members by welding or tacking is prohibited except by written permission from the Bureau Chief of Materials and Research. Permissible locations for such welds and tacks shall be only at locations shown on approved shop drawings or at locations designated in writing by the Engineer. All such tacks or temporary welds shall be made according to Paragraphs 3.3.6 and 3.3.7 and welders and/or tackers shall be qualified according to AWS requirements.

SECTION 2. DESIGN OF WELDED CONNECTIONS.

Add the following to paragraph 2.9.1.1:

Plug welding is prohibited without the written approval of the Engineer. As a requirement for approval, all plug welding shall be QC tested by nondestructive testing at no cost to the state. The type of testing shall be determined by the Engineer.

SECTION 3. WORKMANSHIP.

Delete paragraph 3.2.9.

SUBSECTION 3.5 DIMENSIONAL TOLERANCES.

Add the following to paragraph 3.5.1.2:

Permissible variations in straightness of rolled beams, regardless of cross-section, shall not exceed 0.01inch/foot of beam length or 1 inch.

Delete paragraph 3.5.1.3 and add the following:

3.5.1.3 Permissible variations in specified camber and blocking of welded girders and rolled beams, regardless of cross-section shall not exceed:

-0, + $\frac{1}{4}$ inch for spans (typ., bearing to bearing) 0 thru 100 feet

-0, + $\frac{1}{2}$ inch for spans greater than 100 feet

Permissible variations in blocking of rolled beams at field splices, regardless of cross-section, shall not exceed:

- $\frac{1}{4}$, + $\frac{1}{4}$ inch for spans 0 through 100 feet

- $\frac{3}{8}$, + $\frac{3}{8}$ inch for spans greater than 100 feet

Permissible variations in blocking of welded girders and rolled beams, regardless of cross-section, shall not exceed:

0 for all supports

Sign convention: (-) below, (+) above the detailed values or shape in the no-load condition.

Add 3 new paragraphs as follows:

3.5.1.16 The permissible variation in length of beams or girders between the center line of bearing devices shall not exceed plus or minus $\frac{1}{4}$ inch for any one span or plus or minus $\frac{3}{8}$ inch for any two or more spans. The actual centerline of any bearing device shall lie within the thickness of the bearing stiffener.

3.5.1.17 During shop assembly of horizontally curved welded beams or girders, the allowable variation in specified sweep at internal supports shall be $\frac{1}{4}$ inch.

3.5.1.18 During shop assembly of horizontally curved welded beams or girders, the allowable variation in specified sweep at any point between supports shall be the greater of: $\frac{1}{8}$ inch per 10 feet of length, calculated using the distance to the nearest support, or $\frac{1}{4}$ inch.

SECTION 4. TECHNIQUE.

Add the following notes to Table 4.1:

- Only low hydrogen electrodes shall be used.

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- E 7028 Electrodes may be used for shop fillet welds except for the attachment of gusset plates and bearing stiffeners to girders, bearing stiffeners to beams, web to flange welds and for welding floor beam truss assemblies. Welding shall be in the horizontal and flat positions only.

SECTION 5. QUALIFICATION, PART A.

Replace the first sentence of paragraph 5.2.3 with the following:

All welder, welding operator, and tack welder and PQR tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer. If representatives from other states or third parties witnessed a test, provide records of the test signed by the witness. All mechanical and nondestructive tests performed by independent laboratories on qualification specimens will be at no charge to the State. Provide signed documentation of the independent lab's test results to the Engineer. When requested by the Engineer, allow KDOT access to the test samples and the independent lab's radiographs for inspection.

Delete paragraph 5.2.4 and replace with the following:

5.2.4 Additional Testing. The Engineer may order tests of welders, welding operators, tack welders, or WPSs whenever there is evidence that unacceptable welds are being or have been produced. This additional testing is at the fabricator's expense. The Engineer may disqualify personnel working for the fabricator who fail the additional testing, who commit serious violations of the specifications, or who repeatedly exhibit poor workmanship on KDOT projects.

Revise paragraph 5.2.5 as follows:

Replace "those authorized to examine them." with "the Engineer."

SECTION 5. QUALIFICATION, PART B.

Add the following to paragraph 5.21.6.1:

All tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer.

Revise paragraph 5.21.7 as follows:

Replace "those authorized to examine them." with "the Engineer."

Add the following to paragraph 5.21.7:

If representatives from other states or third parties witnessed a test, records of the test must be signed by the witness.

SECTION 6. INSPECTION, PART A.

Delete paragraphs 6.7.1, 6.7.1.1, and 6.7.1.2 and add the following:

6.7.1 Groove welds in main members as identified in Contract Documents shall be QC tested by nondestructive testing. Unless otherwise specified, radiographic testing shall be used on butt joints. Groove welds in T and corner joints shall be tested by ultrasonic testing. The requirements for radiographic testing and ultrasonic testing apply equally to shop and field welds.

6.7.1.1 Radiographic testing of welds shall be performed according to the following requirements:

- (1) 100% of all welded girder and rolled beam flange butt joints.
- (2) All except the middle 1/3 of all welded girder or rolled beam web butt joints.

6.7.1.2 Ultrasonic testing of welds shall be performed according to the following requirements:

- (1) 100% of each joint subject to calculated tension or stress reversal.
- (2) 25% of each joint subject to compression or shear. If unacceptable discontinuities are found in spot testing, the entire length shall be tested.

Delete paragraphs 6.7.6, 6.7.6.1, 6.7.6.2, 6.7.6.3, 6.7.6.4, and 6.7.6.5 and add the following:

6.7.6 When magnetic particle testing is used, the procedure and techniques shall be in accordance with the dry powder magnetic particle examination of welds using the yoke method.

6.7.6.1 The yoke method shall be performed according to ASTM E 709, and the standard of acceptance with 6.26 of the Code.

- (1) The yoke method shall be performed using half-wave rectified direct current or alternating current.
- (2) Electromagnetic yokes shall have lifting forces complying with **TABLE 705-1**.

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TABLE 705-1: ELECTROMAGNETIC YOKE SPACING		
Current Type	Yoke Pole Leg Spacing (YPS)	
	2"≤YPS<4"	4"≤YPS≤6"
AC	10 lbs.	Not Applicable
DC	30 lbs.	50 lbs.

6.7.6.2 Prior to magnetic particle testing, the surface shall be examined, and any adjacent area within a minimum of 1 inch of the surface to be tested, shall be dry and free of contaminants such as oil, grease, loose rust, loose sand, loose scale, lint, paint, welding flux, and weld spatter.

Cleaning may be accomplished by detergents, organic solvents, descaling solutions, paint removers, vapor degreasing, sand or grit blasting, and ultrasonic cleaning methods.

6.7.6.3 The poles shall be oriented in two directions approximately 90 degrees apart at each inspection point, to detect both longitudinal and transverse discontinuities. The pole position shall overlap as testing progresses to insure 100 percent inspection of the areas to be tested. Discontinuities are best detected when their axis is normal to the magnetic lines of force. Therefore, the yoke technique is most sensitive to discontinuities whose major access is normal to a line drawn between the two poles.

6.7.6.4 A report of magnetic particle examination shall be prepared and provided to the owner.

(1) The report shall include the following minimum information:

- (a) Part identification
- (b) Examination procedure number (if applicable)
- (c) Date of examination
- (d) Technicians name, certification level, and signature
- (e) Name and signature of contractors or owners, Inspectors, or both who witnessed the examination
- (f) Examination results
- (g) Equipment make and model
- (h) Yoke spacing used
- (i) Particle manufacturer's name and color

(2) One copy of the report shall be provided to the contractor for the owner.

Delete paragraph 6.7.7 and add the following:

6.7.7 For detecting discontinuities in non-magnetic materials including stainless steel to stainless steel or stainless steel to carbon steel, liquid penetrate inspection will be used in lieu of magnetic particle inspection. The standard methods, set forth in ASTM E 165 shall be used for liquid penetrate, and the standards of acceptance shall be in accordance with 6.26 of this code.

SECTION 6. INSPECTION, PART B.

Delete paragraph 6.10.9 and add the following:

6.10.9 FILM SIZE - When the joint thickness is less than 3 inches, radiographs shall be 4 1/2 inches x 17 inches in size. When the length of the joint is such that more than one radiograph is required, one of the films may be shortened to 4 1/2 inches x 10 at the contractor option. When joint thicknesses are 3 inches or greater, the minimum film size shall be 7 inches x 17 inches. Larger radiographs may be required in areas where there have been excessive repairs or where there are joints with unusual dimensions.

Delete paragraph 6.10.12 and add the following:

6.10.12 One radiograph identification number shall be painted on the steel no closer than 3/4 inch from the weld edge at each radiograph location. Corresponding lead numbers shall be superimposed on the painted numbers to produce an image on the radiograph. A combination of letters and numbers may also be used. Two location dots shall be painted on the steel at each radiograph location no closer than 3/8 inch from the weld edge. The dots shall be placed at a random distance from the steel plate edges which are perpendicular to the length of the weld. The dots shall be placed in different locations for each radiograph location. One lead arrow shall be placed so that its tip is superimposed on each of the two location dots. A location letter shall be painted immediately under each arrow and a lead letter shall be superimposed on each painted letter. When radiographs are viewed, only those films representing the same joint should have location arrows and location letters perfectly superimposed. Any additional

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information shall be produced on the radiograph no less the 3/4 inches from the edge of the weld either by pre-printing or by placing lead letters and numbers on the steel. See Figure 1 and Figure 2.

Delete paragraph 6.10.13 and add the following:

6.10.13 Information required to be shown on the radiograph shall include: the complete KDOT bridge number, initials of the radiographic inspection company, initials of the fabricator, the fabricator's shop order number, the radiographic identification number, the date, and the weld repair number if applicable.

Add a new paragraph 6.10.15:

6.10.15 Unless otherwise noted on the shop drawings all butt welds will be evaluated as tension welds.

FIGURE 1

ITEMS TO BE PAINTED FOR RADIOGRAPHIC IDENTIFICATION

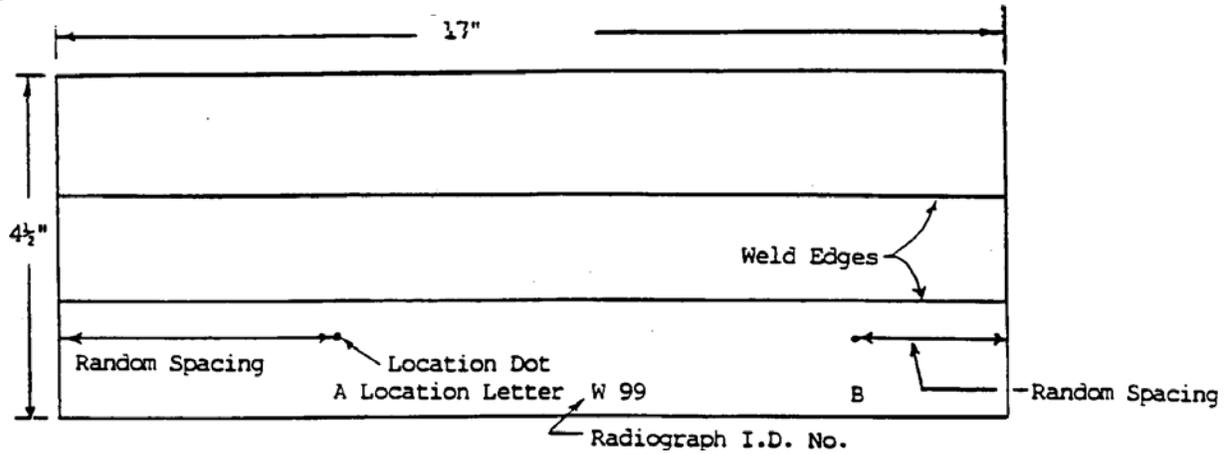
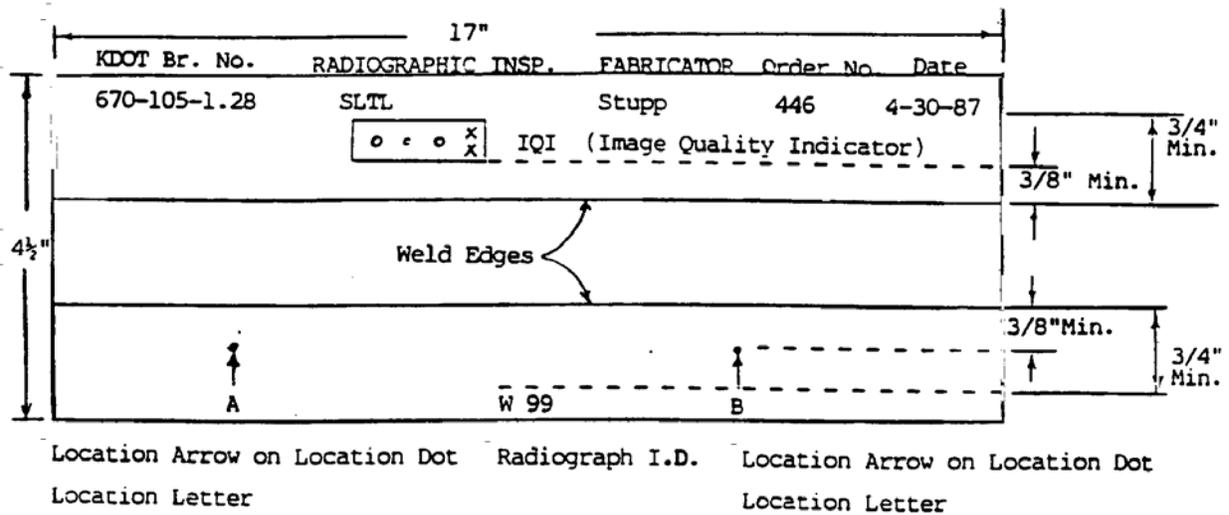


FIGURE 2

LEAD CHARACTER PLACEMENT FOR RADIOGRAPHIC IDENTIFICATION



705.3 MEASUREMENT AND PAYMENT

The Engineer will not measure fabrication of new structural steel for separate payment.