Changes to AASHTO/AWS D1.5:2020 Bridge Welding Code

Prefabricated Structural Materials Section

Compiled by: VJ Pillai and Teresa Michalk, P.E.

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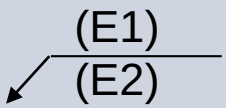
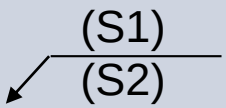
Clause 1: General Provisions

D1.5:2015	D1.5:2020
1.2.2 Approved Base Metals. *ENTIRE SECTION REPLACED*	**1.2.2 Approved Base Metals** Base metals to be welded under this code shall meet the requirements of ASTM A709 for the following grades: (1) 36 (2) [50] (Type 1, 2, or 3) (3) 50S (4) 50W (5) HPS 50W (6) HPS 70W or (7) HPS 100W

Clause 1: General Provisions

D1.5:2015	D1.5:2020
The terms ‘flaw’ ‘discontinuity’ and ‘defect’ were used throughout the code • Flaw – An undesirable discontinuity	Either ‘discontinuity’ or ‘defect’ are used. Eliminated the use of the term ‘flaw’ • Discontinuity - Any geometric disruption to the weld and can be on the surface, internal or both internal and surface. • Defect – A rejectable discontinuity

Clause 2 (Now Clause 4): Design of Welded Connections

D1.5:2015	D1.5:2020
2.1.3.1 The welding symbol with ~~dimensions~~ above or below the ~~arrow~~ designates a PJP weld, as follows:  E1 = Effective weld size, other side E2 = Effective weld size, arrow side --- **2.13.2 Minimum Effective Weld Size.** (2nd para.): "Shop or working drawings shall specify the groove depths ~~(S)~~ applicable for the effective weld size ~~(E)~~ required for the welding process and position of welding to be used."	**Clause <u>4.1.3.1</u>** The welding symbol with <u>the effective groove weld size (S) above or below the reference line designates a PJP weld as follows:</u>  S1 = Effective weld size (other side) S2 = Effective weld size (arrow side) --- **<u>4.13.2</u> Minimum Effective Weld size.** (2nd para.) Shop or working drawings shall specify the groove depths <u>(D)</u> applicable for the effective weld size <u>(S)</u> required for the welding process and position of welding to be use.

Clause 2 (Now Clause 4): Design of Welded Connections

D1.5:2015	D1.5:2020
2.17.3 Connections or Splices in Compression Members with Milled Joints. If members subject only to compression are spliced and full-milled bearing is provided, the splice material and its welding shall be arranged, unless otherwise stipulated by the applicable general specifications, to hold all parts in alignment and shall be proportioned to carry 50% of the computed stress in the member. Where such members are in full-milled bearing on base plates, there shall be sufficient welding to hold all parts securely in place.	**4.17.3 Connections in Compression with Finished-to-Bear Joints.** If members subject only to compression are spliced and a finished-to-bear fit is provided, the welding shall be arranged to hold all parts in alignment, and welds and contact areas shall be proportioned to each carry 50% of the computed stress in the member. Where such members are finished to achieve direct bearing on base plates, contract tolerances shall satisfy the second paragraph of 5.5.9 and there shall be sufficient welding to hold all parts securely in place.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.2.1 Surfaces and edges to be welded shall be smooth, uniform, and free from fins, tears, cracks, and other discontinuities that would adversely affect the quality or strength of the weld. Surfaces to be welded and surfaces adjacent to a weld shall also be free from loose or thick scale, slag, rust, moisture, grease, and other foreign material that would prevent proper welding or produce objectionable fumes.	**5.2.1 General** Base metal shall be sufficiently clean to permit welds to be made that will meet the weld quality requirements of this code. **5.2.2 Mill-Induced Surface Defects.** Welds shall not be placed on surfaces that contain fins, tears, cracks, slag, or other base metal defects as defined in the base metal specifications.

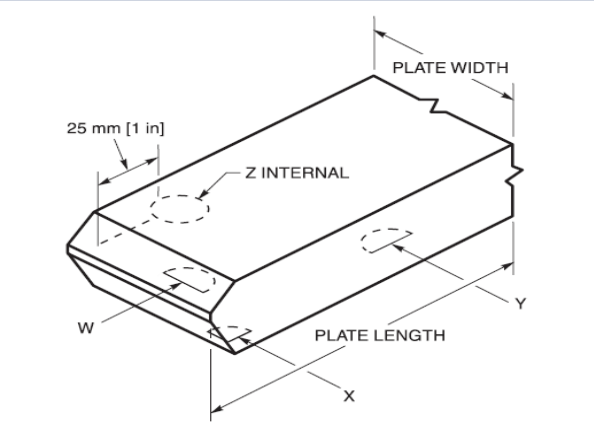
Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.2.1 Mill scale that can withstand vigorous wire brushing, a thin rust-inhibitive coating, or antispatter compound may remain except that all mill scale shall be removed from the surfaces on which web-to-flange welds are to be made.	**5.2.3 Scale and Rust.** Loose scale, thick scale, and thick rust shall be removed from the surfaces to be welded within 1 in of the weld. Welds may be made on surfaces that contain thin mill scale and rust if: (1) The mill scale and rust can withstand vigorous hand wire brushing; and (2) If the applicable weld quality requirements of this code can be met. All mill scale shall be removed from the following: (1) web-to-flange connections (2) joint boundaries of groove welds subject to calculated tensile stress

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
	5.2.4 Foreign Materials 5.2.4.1 Surfaces to be welded, and surfaces adjacent to the weld, shall be cleaned to remove evident quantities of the following: • Water • Oil • Grease • Other hydrocarbon based materials Welding on surfaces containing residual amounts of foreign materials is permitted providing the weld quality requirements of this code can be met. **5.2.4.2** Welds are permitted to be made on surfaces with anti-spatter compounds or protective coatings applied providing the weld quality requirements of this code can be met. Protective coatings are not permitted on web-to-flange connections or joints subject to calculated tensile stress.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.2.3.7(2) *last paragraph* The discontinuity on the cut edge of the base metal shall be gouged out to a depth of 1 in before its intersection with the surface by chipping, air carbon arc gouging, or grinding, and shall be blocked off by SMAW in layers not exceeding 1/8 in in thickness.  Figure 3.1—Discontinuities in Cut Plate (see 3.2.3.6)	**5.2.6.7(2)** *last paragraph* The discontinuity on the cut edge of the base metal shall be gouged out to a depth of 1 in below its intersection with the surface by chipping, air carbon arc gouging, or grinding to form a groove cross section with a minimum groove radius of ¼ in and a minimum groove angle (α) of 20 degrees, and shall be blocked off by SMAW, FCAW-G, or GMAW in at least four weld layers not exceeding 1/8 in in thickness per layer. The repair may be completed by SAW (except for active fluxes), SMAW, FCAW-G, or GMAW with normal restrictions on layer thickness and welding processes.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.2.6 Joint and edge preparation may be done by machining, thermal cutting, air carbon arc cutting and gouging, plasma arc gouging, or chipping and grinding. Removal of unacceptable weld or base metal and backgouging shall be done by machining, air carbon and plasma arc gouging, or chipping and grinding.	**5.2.9** Joint and edge preparation and removal of unacceptable weld or base metal may be done by machining, thermal cutting, plasma or air carbon arc cutting and gouging, grinding, or chipping, followed by grinding to remove residue and satisfy the WPS-specified joint geometry.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.3.7.1 Tack welds shall be subject to the same quality requirements as the final welds, with the following exceptions: (1) Preheat is not mandatory for single-pass tack welds that are remelted and incorporated into continuous SAW, ESW, or EGW welds. (2) Discontinuities such as undercut, unfilled craters, and porosity need not be removed before the final SAW, ESW, or EGW that remelts the tack weld (see 3.3.8)	**5.3.7.1** Tack welds shall be subject to the same requirements as the final welds, except as exempted in 5.3.7.3. Tack welding shall be performed in accordance with a WPS meeting the requirements of Clause 5 unless exempted by 5.3.7.3. Tack welds shall be cleaned and visually inspected before subsequent welding.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.3.7.2 Tack welds incorporated into the final weld shall be made with electrodes meeting the requirements of the final welds and shall be cleaned thoroughly. Multiple-pass tack welds shall have cascaded ends.	**5.3.7.2** Multipass tack welds shall have cascaded ends.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
This clause is new in this version of the code.	**5.3.7.3 Remelted Tack Welds.** Tack welds made in accordance with 5.3.7.3(1) and 5.3.7.3(2) shall be considered fully remelted and incorporated into the final weld and shall be exempt from the following requirements: (a) Minimum preheat requirements shall not apply. (a) WPSs for tack welding shall not require qualification testing in accordance with Clause 7

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
	5.3.7.3 (1) Exemption Requirements. The following conditions shall be met for the exemptions of 5.3.7.3 to apply: (a) The tack welds shall be made in single pass. (b) The filler metal for tack welding is listed in Table 6.1 (c) No other welding process my be used to weld over a FCAW-S tack weld unless qualified by 7.7.7.1. **5.3.7.3 (2) Remelting Conditions.** To ensure that tack welds are fully remelted, the following shall apply: (a) The remelting capability of the subsequent welding process and procedure is verified by macroetch in accordance with 7.18.2 and 7.19.2. (b) The maximum tack weld size used in production shall not exceed the tack weld size used in the qualification testing. (c) The heat input of the pass used to remelt the tack in production shall not be less than that used in the qualification testing.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.3.7.3 Tack welds not incorporated into the final weld shall be removed in such a manner that the base metal is not nicked or undercut. Repair of base metal accidentally removed shall be approved by the Engineer prior to making the repair. If the repair involves welding, it shall be in conformance with 3.7.1.	**5.3.7.4 Unincorporated Tack Welds.** **(1) Removal.** Tack welds not incorporated into final weld shall be removed in such a manner that the base metal is not damaged. Base metal damaged during tack weld removal may be repaired when approved by the Engineer. If the repair involves welding, it shall be done in conformance with 5.7.1. **(2) Cracked Base Metal.** The removal of tack welds may expose cracked base metal. When cracked base metal is discovered after tack welds are removed, all other tack weld removal locations in the tension regions on the member shall be tested by magnetic particle testing (MT) to assure that no cracks are present. If the MT testing reveals cracks, hardness testing of the HAZ shall be required. Hardness values shall not exceed Rockwell C30 in the HAZ. These excessively hard HAZs shall be removed by shallow grinding.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
This clause is new in this version of the code.	**5.3.7.5 Broken Tack Welds** **(1) General.** If a tack weld breaks before welding of the joint has begun, the broken tack weld shall be removed, and if necessary, replaced. **(2) Exemptions.** Tack welds that meet the requirements of 5.3.7.3 need not be repaired if the tack breaks after welding on that particular joint has begun.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
3.4.8 Members distorted by welding shall be straightened by mechanical means and/or by carefully supervised application of a limited amount of localized heat. The temperature of the heated areas as measured by approved methods shall not exceed 1100°F for M 270M/ M 270 (A709/A709M) Grades HPS 485W [HPS 70W] and HPS 690W [HPS 100W] steels or 1200°F for other steels. The part to be heated for straightening shall be substantially free of stress from external forces, except stresses resulting from the mechanical straightening methods used in conjunction with the application of the heat. ****THIS SECTION HAS BEEN SIGNIFICANTLY REWORDED.**	**5.4.8** To achieve or restore the required geometry, elements may be aligned by: (1) Applied force causing yielding ("mechanical bending") (2) Methods that use controlled heating with restraint or support (including "heat shrink" or upset shortening) (3) With Engineer approval, by a combination of controlled heating and mechanical means. 5.4.8.1. Elements to be heated shall be supported to minimize stress from gravity and external forces that would interfere with the desired results.

Clause 3 (Now Clause 5): Workmanship

D1.5:2015	D1.5:2020
These clauses are new in this version of the code.	**5.4.8.2.** For any application of heat, the maximum temperature of the heated areas shall not exceed 1100° F for A709 Grades HPS 70W and HPS 100W steels, or 1200° for the other steels listed in Table 6.1. **5.4.8.3** Accelerated cooling shall not be applied to steel above 600° F. **5.4.8.4** When mechanical means are used in combination with heat, the force shall not be initially applied or increased when steel temperature is either below 40° F or between 300° F and 700° F. **5.4.8.5** Mechanical forces shall be released before welding the element to other members.

Clause 4 (Now Clause 6): Technique

D1.5:2015	D1.5:2020
4.1.1 Matching Filler Metal. For matching weld metal, the electrode or electrode/flux combination shall be selected from Table 4.1 for the base metal to be used in the work.	**6.1.1** Matching Filler Metal. For matching weld metal, the electrode or electrode/flux shall be selected from Table 6.1 for the base metal to be used in the work. WPSs for joints involving two base metals of different specified yield strengths shall use filler metal matching the lower strength base metal.
4.1.2.1 For weld joints containing A709/A709M Grade HPS 70W and Grade HPS 100W materials, the maximum filler metal diffusible hydrogen content shall not exceed 8 mL/100 g of deposited weld metal as determined by AWS A4.3, *Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding*, with the preheat requirements of Table 4.3.	**6.1.2.1** For weld joints containing A 709 Grade HPS 70W materials, the maximum filler metal diffusible hydrogen content shall conform to the diffusible hydrogen requirements of the AWS filler metal specifications optional supplemental designator H8. GMAW with solid electrodes shall be considered to meet this requirement.

Clause 5 (Now Clause 7): Qualification

D1.5:2015	D1.5:2020
5.4.1 Base-Metal Qualification Requirements. The production base metals qualified by the PQR base metal shall conform to the following:	**7.4.1 Base-Metal Qualification Requirements**. For qualification of WPSs for approved base metals listed in 1.2.2. The filler metal, base metal, and backing used in the qualification test shall conform to Table 7.1, which lists the base materials that may be used in the test for a given production filler metal and base metal. Equivalent ASTM Steels shall be permitted for use as qualification test plates in accordance with Table 7.2.

Clause 5 (Now Clause 7): Qualification

Table 7.1

Base Metal Options for WPS Qualification Test Plates ASTM A709 Grades (see 7.4 and C-7.4)

Filler Metal Strength to be listed on WPS (ksi)	Base Metal Grade to be listed on WPS			
	Gr. 36	Gr. 50, 50S, 50W, HPS 50W	Gr. HPS 70W	Gr. HPS 100W
60	Gr. 36, or 50, or 50W, or HPS 50W	Gr. 36, or 50, or 50W, or HPS 50W	Gr. 36, or 50, or 50W, or HPS 50W	Gr. 36, or 50, or 50W, or HPS 50W
70 or 80	Gr. 36, or 50, or 50W, or HPS 50W	Gr. 50, 50W, HPS 50W	Gr. 50, 50W, HPS 50W	Gr. 50, 50W, HPS 50W
90	—	—	Gr. HPS 70W	Gr. HPS 70W
100 or 110	—	—	—	Gr. HPS100W

Clause 5 (Now Clause 7): Qualification

Table 7.2 (see 7.4 and C-7.4)

AASHTO and ASTM Equivalent Base Metal Grades

AASHTO A709/A709M Grade	ASTM equivalent
Gr. 36	A36
Gr. 50	A572, Gr. 50
Gr. 50W	A588, Gr. A or B

Clause 5 (Now Clause 7): Qualification

D1.5:2015	D1.5:2020
5.5.1 WPS Requirements for Consumables. See Table 5.2 for the WPS qualification requirements for consumables.	**7.5.1 WPS Requirements for Consumables.** See Table 7.4 for the WPS qualification requirements for consumables. If the name of a manufacturer changes (e.g., merger or acquisition) or if the brand name or type of a consumable is revised without reformulation or other physical changes, such changes shall not constitute a change that requires WPS requalification. New WPSs may use the new identity based upon a PQR retaining the old information. Existing WPSs shall be revised to list the new identity while based upon a PQR retaining the old information. Documentation from the manufacturer explaining the change shall be filed with the PQR.

Clause 5 (Now Clause 7): Qualification

D1.5:2015	D1.5:2020
5.7.5 Joints not conforming to Figure 2.4 or 2.5. When the Contractor uses groove weld details that do not conform to the details of Figure 2.4 or 2.5, the WPSs using these details shall be qualified by test as described in 5.12.4 using Figure 5.3. Bend and tensile tests shall be used to evaluate soundness. The mechanical properties of the weld metal shall be determined by the WPS testing described in 5.12, using Figure 5.1.	**7.7.5 Joints Not Conforming to Figure 4.4 or 4.5** When the Contractor uses groove weld details that do not conform to the details of Figure 4.4 or 4.5, the WPSs using these details shall be qualified by test as described in 7.12.4 using Figure 7.3. Bend and tensile tests shall be used to evaluate soundness. The mechanical properties of the weld metal shall be determined by the WPS testing described in 7.12, using Figure 7.1 Test plates for groove welds in corner or T-joints shall be butt joints having the same groove configuration as the corner or T-joint to be used in construction, except the depth of groove need not exceed 1 in.

Clause 5 (Now Clause 7): Qualification

D1.5:2015	D1.5:2020
5.23.3 Tack Welder Qualification. A tack welder shall be qualified by one fillet weld break specimen made in each position in which tack welds are to be made. The tack welder shall make a ¼ in maximum size tack weld approximately 2 in long on the fillet weld break specimen, as shown in Figure 5.28.	**7.23.3 Tack Welding Qualification.** The following options shall qualify an individual to perform tack welding for the process used in the test, for any thickness: (1) For tack welding qualification only, the individual shall make a tack weld no greater than ¼ in. in size and 2 in long on the fillet weld specimen shown in Figure 7.28, for each position in which tack welds are to be made. (2) A welder qualified by Options (1), (2), or (3) in 7.23.1 or by the test described in 7.23.1.1 shall also be qualified to tack weld. Tack welders shall be qualified to weld in the positions permitted by 7.22.

Clause 6 (Now Clause 8): Inspection

D1.5:2015	D1.5:2020
6.7.1.2 RT and UT of welds shall be performed in conformance with the following frequency requirements: *The remainder of the section has been reworded or reformatted.*	8.7.2 **Partial NDT of Transverse Butt Joints in Webs.** If partial NDT of transverse butt joints in webs is required and a defect is found in the tested length, the uninspected remainder of the weld shall be tested by UT or RT as required for the type of loading by Table 8.1. If a defect is found in any test length of a weld in a transverse butt joint in a web, the remainder of the weld shall be tested by UT or RT as required for the type of loading by Table 8.1.

Clause 6 (Now Clause 8): Inspection

Table 8.1 NDT Methods and Frequency					
Weld Type	Joint Type	Process	Member Design Stress Type	NDT Method	Frequency
CJP groove welds	Butt joints other than in webs of flexural members	Other than ESW or EGW	Tension or reversal	RT	100% of each joint
			Compression or shear	UT or RT	25% (See 8.7.3)
		ESW or EGW	Tension or reversal	RT and UT	100 of each joint
			Compression or shear		25% (See 8.7.3)
	Butt joints in webs of flexural members, transverse to the direction of bending stress	Other than ESW or EGW	Tension	RT	1/6 of the web depth beginning at the tension flange or flanges for each joint
		ESW or EGW		RT and UT	
		Other than ESW or EGW	Compression	UT or RT	25% of the remainder of the web depth for each joint
		ESW or EGW		RT and UT	
	Butt joints in webs of flexural members, parallel to the direction of bending stress	Other than ESW or EGW	Shear	UT or RT	25% (See 8.7.3)
		ESW or EGW		RT and UT	
	T- or corner joints	Any	Tension or reversal	UT	100% of each joint
			Compression or shear (including web to either flange)		25% (See 8.7.4)

Clause 6 (Now Clause 8): Inspection

Table 8.1 NDT Methods and Frequency					
Weld Type	Joint Type	Process	Member Design Stress Type	NDT Method	Frequency
PJP groove welds and fillet welds, Grade HPS 100W	Any	Any	Any	MT	100% of each joint
PJP groove welds and fillet welds, all other grades					10% (See 8.7.4)

Clause 6 (Now Clause 8): Inspection

D1.5:2015	D1.5:2020
6.7.2 and 6.7.2.1 *were reworded/reformatted*	**8.7.4 Fillet Welds and PJP Groove Welds.** Requirements for 10% testing given in Table 8.1 shall be satisfied by 8.7.4.1 or 8.7.4.2 as applicable. **8.7.4.1 Long Welds.** For welds 10 ft or longer, at least 12 in shall be tested in every 10 ft length. If a defect is found in any test length of weld, the full length of the weld, or 5 ft on both sides of the test length, whichever is less, shall be tested. **8.7.4.2 Short Welds.** Welds less than 10 ft in length shall be tested on either a per-joint or per-lot basis in accordance with either 8.7.4.2(1) or 8.7.4.2(2), respectively. **(1) Testing on Per-Joint Basis.** At least 12 in of each weld shall be tested. If a defect is found in any test length, the full length shall be tested. **(2) Testing on Lot Basis.** 10% of the total joints in a lot as defined in 8.7.3.3 shall be tested for their full length. Joints tested on a lot basis shall be distributed throughout the work and shall be total at least 10% of the applicable fillet weld or PJP weld length. If defects are found in 20% or more of the joints tested in a lot, all joints in that lot shall be tested for their full length.

Clause 6 (Now Clause 8): Inspection

D1.5:2015	D1.5:2020
6.7.8 Phased-array UT (PAUT) in accordance with Annex K may be substituted for conventional UT (as described in Part C of this clause).	**8.7.10** Phased-array UT (PAUT) in accordance with Annex J may be substituted for conventional UT (as described in Part C of this clause).

REMEMBER: PAUT is NOT a substitute for UT when used in lieu of RT!

Clause 6 (Now Clause 8): Inspection

D1.5:2015	D1.5:2020
K4.1 Personnel Qualification Requirements. …In satisfying the requirements of 6.1.3.4, the qualification of the PAUT operator shall include a specific and practical examination that shall be based on the requirements of this code. This examination shall require the PAUT operator to demonstrate the ability to apply the rules of this code in the accurate detection and disposition of discontinuities.	**J4.1** …Additionally, individuals shall be certified as: (a) UT Level II in accordance with 8.1.3.4 (1) and have supplemental qualifications for PAUT; or (b) UT Level III in accordance with 8.1.3.4 (3) and have supplemental qualifications for PAUT. This includes Level III Personnel who collect and analyze PAUT data. Supplemental qualifications for PAUT shall include the following:. (1) A written test based on PAUT requirements of this code. (2) PAUT examinations of at least two welded joints (e.g. butt, T, corner) that contain real or artificial discontinuities to be examined using a phased array procedure written in accordance with this Annex. (3) 320 hours of PAUT work experience.

Clause 6 (Now Clause 8): Inspection

D1.5:2015	D1.5:2020
K4.1	**J4.1 (continued)** Individuals meeting the supplemental requirements except the work experience shall have data and reports reviewed and confirmed by a UT Level II with the supplemental PAUT qualifications or UT Level III with the supplemental PAUT qualifications.

Clause 6 (Now Clause 8): Inspection

D1.5:2015	D1.5:2020
6.9 General **6.9.1** The procedures and standards set forth in Part B… *Added additional requirements*	**8.9 General** **8.9.1 Procedures and Standards.** The procedures and standards set forth in Part B govern radiographic testing of welds. The requirements described herein are specifically for testing groove welds in butt joint in plate, shapes, and bars by X-ray or gamma ray sources. The methods shall conform to ASTM E94, *Standard Guide for Radiographic Examination* and; ASTM E1032, *Standard Test Method for Radiographic Examination of Weldments*. The digital image archival method shall be in accordance with ASTM E2339, *Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE).*

Clause 6 (Now Clause 8): Inspection

D1.5:2015	D1.5:2020
	8.10.1.1 Digital Radiography. At the option of the Contractor, the digital radiography method shall be either computed radiography (CR) using a photostimulable phosphor plate, more commonly known as a storage phosphor imaging plate (SPIP), or direct radiography (DR) using a Digital Detector Array (DDA). (1) CR shall comply with ASTM E2033, *Standard Practice for Computed Radiography (Photostimulable Luminescence Method)* and ASTM E2445, *Standard Practice for Qualification and Long-Term Stability of Computed Radiography Systems.* (2) DR shall be comply with ASTM E2698, *Standard Practice for Radiographic Examination Using Digital Detector Arrays and ASTM E2737, Standard Practice for Digital Detector Array Performance Evaluation and Long-Term Stability.*

Clause 7 (Now Clause 9): Stud Welding

D1.5:2015	D1.5:2020
7.7.5 If an unacceptable stud has been removed from a component subjected to tensile stresses, the area from which the stud was removed shall be made smooth and flush. **7.7.5.1** Where in such areas the base metal has been pulled out in the course of stud removal, SMAW with low-hydrogen electrodes in conformance with the requirements of this code shall be used to fill the pockets, and the weld surface shall be ground flush.	**9.7.5.1 Components Subject to Calculated Tensile Stress.** If an unacceptable stud has been removed from a component subjected to calculated tensile stresses and no base metal has been pulled out, the area from which the stud was removed shall be finished with no surface irregularities exceeding either 1/32 in. parallel to the calculated tensile stress or 0.010 in. perpendicular to calculated tensile stress. When base metal has been pulled out by stud failure, all resulting fractured and projecting material shall be removed. If the maximum removal depth does not exceed 3/16 in or 20% of the component thickness, whichever is less, and after finishing, the remaining net cross-sectional section area of the member component (e.g., flange) is at least 98% of its nominal cross-sectional area, no repair weld is needed, and the damaged area shall be faired to the surface at a slope not exceeding 1 in 10. If damage exceeds any of the preceding limits, the depression shall be filled by welding in conformance with this code, and the weld surface shall be finished flush. A WPS in conformance with this code shall be used to fill the depression, and the weld surface shall be finish flush. Machine or grinding marks from final finishing shall be parallel to the calculated tensile stress with no irregularities above or below the surface exceeding either 1/32 in. parallel to tensile stress or 0.010 in. perpendicular to the tensile stress.

Clause 7 (Now Clause 9): Stud Welding

D1.5:2015	D1.5:2020
7.7.5.2 In compression areas of members, if stud failures are confined to shanks or fusion zones of studs, a new stud may be welded adjacent to each unacceptable area in lieu of repair and replacement on the existing weld area (see 7.4.3). If base metal is pulled out during stud removal, the repair provisions shall be the same as for tension areas, except that when the depth of discontinuity is the lesser of 1/8 in or 7% of the base metal thickness, the discontinuity may be faired by grinding in lieu of filling with weld metal.	**9.7.5.2** Components Only Subject to Compressive Stress. In compression areas of members, if stud failures are confined to shanks or fusion zones of studs, a new stud may be welded adjacent to each unacceptable area in lieu of repair and replacement on the existing weld area, if stud spacing permits (see 9.4.5). Surface finishing of the stud removal area is not required in this case. If base metal is pulled out by stud failure, the repair provisions shall be the same as for areas subject to calculated tension (sec 9.7.5.1), except final finishing may be in any direction and deviations from the local surface are limited to a maximum of 1/32 in. in all directions.

Changes to AWS D1.5:2020 Bridge Welding Code

D1.5:2015	D1.5:2020
Tubular Structures No Applications within this code	**Tubular Structures** NO APPLICATIONS WITHIN THIS CODE

Clause 12: AASHTO/AWS Fracture Control Plan (FCP) for Nonredundent Members

D1.5:2015	D1.5:2020
12.2.2 Fracture Critical Member (FCM). Fracture critical members or member components are tension members or tension components of bending members (including those subject to reversal of stress), the failure of which would be expected to result in collapse of the bridge. The designation "FCM" shall mean fracture critical member or member component. Members and components that are not subject to tensile stress under any condition of live load shall not be defined as fracture critical.	**12.2.2 Fracture Critical Member (FCM).** AASHTO LRFD Bridge Design Specifications define an FCM as a steel primary member or portion thereof subject to tension whose failure would probably cause a portion of or the entire bridge to collapse.

Questions?