Changes to the AWS D1.5 - 2015 Bridge Welding Code

Advantages of Publishing Every 5 Years

- Coordinated with the AASHTO Publication Cycle
- Easier to manage multiple projects that may have required different editions of D1.5 in the past.
- Code was Published in 2015 and is currently on a five year publication cycle.
- Code is recognized by all fifty States and many regulatory agencies

Methods used to indentify D1.5 Code changes

- Foreword discusses “most significant technical changes”
- Text changes are underlined
- Table and figure changes noted with vertical bars

Underline

(2) when surfaces are wet or exposed to rain, snow, or

(3) high wind velocities, or

(4) when welding personnel are exposed to inclement conditions.

NOTE: Zero °F does not mean the ambient environmental temperature, but the temperature in the immediate vicinity of the weld. The ambient environmental temperature may be below 0°F [–20°C], but a heated structure or shelter around the area being welded must maintain the temperature adjacent to the weldment at 0°F [–20°C] or higher.

5.12 Conformance with Design

The size and lengths of welds shall be no less than those specified by design requirements and detail drawings, except as allowed in Table 6.1 or Table 6.10. The location of welds shall not be changed without approval of the Engineer.

5.13 Minimum Fillet Weld Sizes

The minimum fillet weld size, except for fillet welds used in tubular groove welds, shall be as shown in Table 5.1. The minimum fillet weld size shall apply in all cases, unless the design drawings specify welds of a larger size.

5.14 Preparation of Base Metal

5.14.1 General. Base metal shall be sufficiently clean to permit welds to be made that will meet the quality requirements of this code.

5.14.2 Mill-Induced Surface Defects. Welds shall not be placed on surfaces that contain slivers, tears, cracks, slag, or other base metal defects as defined in the base metal specifications.

5.14.3 Scale and Rust. Loose scale, thick scale, and thick rust shall be removed from the surfaces to be welded, and from surfaces adjacent to the weld. Welds may be made on surfaces that contain mill scale and rust if the mill scale and rust can withstand vigorous wire brushing and if the applicable quality requirements of this code are met with the following exception: for girders in cyclically loaded structures, all mill scale shall be removed from the surfaces on which flange-to-web welds are to be made.

5.14.4 Foreign Materials

5.14.4.1 Surfaces to be welded and surfaces adjacent to the weld, shall be cleaned to remove excessive quantities of the following:

(1) Water

(2) Oil

(3) Grease

(4) Other hydrocarbon based materials

Welding on surfaces containing residual amounts of foreign materials is permitted provided the quality requirements of this code are met.

5.14.4.2 Welds are permitted to be made on surfaces with surface protective coatings or anti-spatter compounds, except those that are prohibited in 5.14.4.1, provided the quality requirements of this code can be met.

5.14.5 Mill-Induced Discontinuities. The limits of acceptability and the repair of visually observed cut surface discontinuities shall be in conformance with Table 5.4, in which the length of discontinuity is the visible long dimension on the cut surface of material and the depth is the distance that the discontinuity extends into the material from the cut surface. All welded repairs shall be in conformance with this code. Removal of the discontinuity may be done from either surface of the base metal. The aggregate length of welding shall not exceed 20% of the length of the plate surface being repaired except with approval of the Engineer.

5.14.5.1 Acceptance Criteria. For discontinuities greater than 1 in [25 mm] in length and depth discovered on cut surfaces, the following procedures shall be observed.

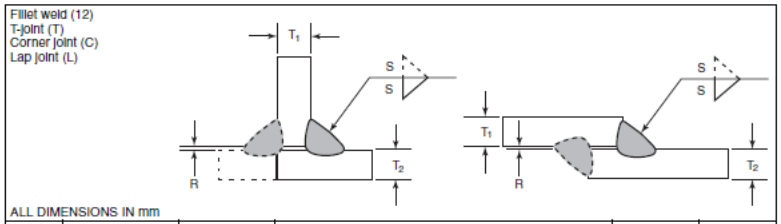
(1) When discontinuities such as W, X, or Y in Figure 5.1 are observed prior to completing the joint, the size and shape of the discontinuity shall be determined by UT. The area of the discontinuity shall be determined as the area of total loss of back reflection, when tested in conformance with the procedure of ASTM A435, *Specification for Straight Beam Ultrasonic Examination of Steel Plates*.

(2) For acceptance of W, X, or Y discontinuities, the area of the discontinuity (or the aggregate area of multiple discontinuities) shall not exceed 4% of the cut material area (length times width) with the following exception: if the length of the discontinuity, or the aggregate width of discontinuities on any transverse section, as measured perpendicular to the cut material length, exceeds 20% of the cut material width, the 4% cut material area shall be reduced by the percentage amount of the

Vertical Bars

Notes for Figure 3.5

[a] Fillet weld size ("S"). See 2.4.2.8 and Clause 5.14 for minimum fillet weld sizes. See Table 3.7 for maximum single pass size.
[b] See 5.22.1 for additional fillet weld assembly requirements or exceptions.
[c] See 2.4.2.9 for maximum weld size in lap joints.
[d] Perpendicularity of the members shall be within ±10°.



ALL DIMENSIONS IN mm

Welding Process	Joint Designation	Base Metal Thickness T_1 or T_2	Joint Design/Geometry: Root Opening	Joint Design/Geometry: Tolerances: As Detailed	Joint Design/Geometry: Tolerances: As Fit-Up	Allowed Welding Positions	Notes
SMAW	TC-F12	<3	R = 0	+1/16, –0	[illegible]	All	a, b, d
	TC-F12a	≥3			5/16 max.		[illegible]
	L-F12	<3			3/16 max.		a, b, c
	L-F12a	≥3			5/16 max.		a, b, c
FMAW FCAW	TC-F12-GF	<3	R = 0	+1/16, –0	3/16 max.	All	a, b, d
	TC-F12a-GF	≥3			5/16 max.		a, b, d
	L-F12-GF	<3			3/16 max.		a, b, c
	L-F12a-GF	≥3			5/16 max.		a, b, c
SAW	TC-F12-S	<3	R = 0	+1/16, –0	3/16 max.	F, H	a, b, d
	TC-F12a-S	≥3			5/16 max.		a, b, d
	L-F12-S	<3			3/16 max.		a, b, c
	L-F12a-S	≥3			5/16 max.		a, b, c

Figure 3.5—Prequalified Fillet Weld Joint Details (Dimensions in Inches) (see 3.9)

D1.5 Code changes that will be addressed

- This presentation is not all comprehensive
- Major Technical changes only will be discussed
- Organizational changes will not be discussed
- Miscellaneous changes in Tables and Sample Forms will not be identified at this time.
- Additions to existing tables will not be discussed.

Fillet Weld PQR Testing Changes

Single Pass Fillet Welds are exempt from Groove Weld Qualification PQR Testing

Added new to AWS D1.5 Code

5.10.1 Exemption from Groove Weld Qualification for Fillet WPS. Groove weld testing is not required to qualify WPSs for single pass fillet welds.

Justification for changes

- Groove Weld PQRs do not represent the mechanical properties of single-pass fillet welds well and do not reflect the ability of the WPs to produce fillet welds that meet the Code
- Using a groove weld to qualify fillet welds is detrimental to the use of preferred filler metal and fluxes uniquely suited to improve fillet welds
- The result of this Code change is that you now can produce quality fillet welds with better productivity

Phased Array Ultrasonic Testing

Phased Array Ultrasonic Testing may now be substituted for conventional UT

Added new to AWS D1.5 – 2015 Code

6.7.8 Phased array UT (PAUT)(as described in Part C of this clause) in accordance with Annex K may be substituted for conventional UT

Advantages of Phased Array UT Testing

- Welds are ultrasonically examined by sweeping through multiple sound beam angles from 45 to 70 degrees refraction which significantly improves detection of weld defects.

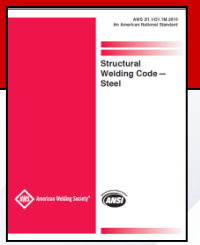
- Encoding the scan allows for informative imaging and a permanent electronic record

- The combination of encoding and swept angles results in repeatability and makes it unlikely that an operator will miss a discontinuity

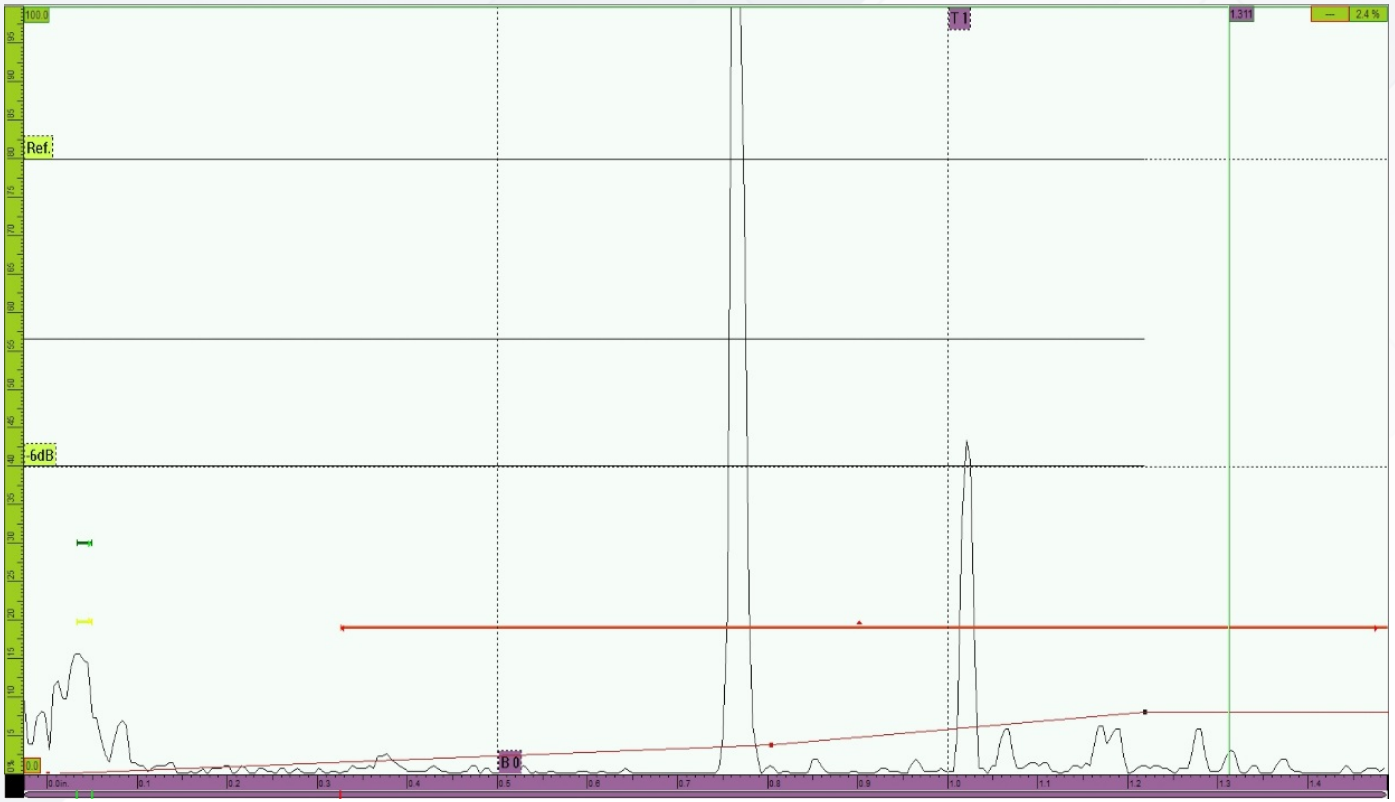
Advantages of Phased Array UT Testing Cont

- Under the new Annex K, Primary Reference Level sensitivity is still the 1/16 inch diameter side drilled hole used for conventional UT.

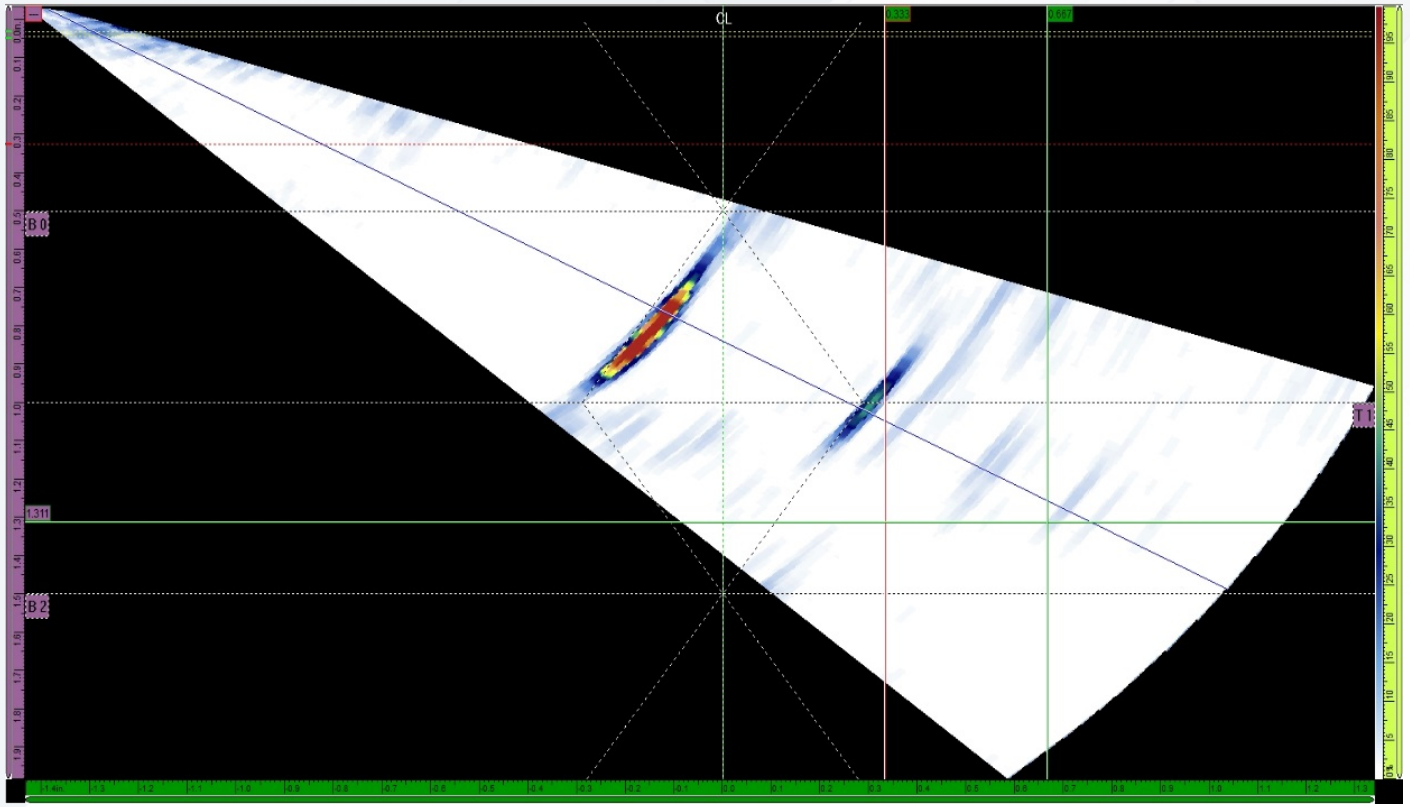
- PAUT may be substituted for RT when approved by the Engineer



UT Scope “A Scan” Presentation -- Single Angle



Phased Array Sectorial "S-Scan" Image Showing Multiple Angles



Significant Heat Input Changes

- **Clause 5** Heat Input qualification requirements have been revised
- Broadened voltage limits
- Added a new amperage limit table for production qualification method
- Removed prequalification based on restrictions in lieu of variables qualified by test

Change in PQR Time Limits

5.3 Duration All approved PQRs are valid indefinitely unless application of the WPS results in consistently substandard welds.

Major Technical Change

12.6 Consumable Requirements

12.6.1 Heat or Lot Testing. All welding consumables shall be heat or lot tested by the manufacturer to determine conformance with the requirements of this FCP.

2010

AWS D1.5 – 2010 Code Requirements

~~12.6 Consumable Requirements~~

~~12.6.1 Heat or Lot Testing. All welding consumables shall be heat or lot tested by the manufacturer to determine conformance with the requirements of this FCP.~~

2015

Justification for Changes

Testing by Electrode Manufacturers that produce quality filler metal product under a continuing quality assurance program, audited and approved by one or more of the agencies described in 12.6.1.1 have proven that their quality is consistent and no additional testing of the filler metal is required

AWS D1.1 Code Compared to AWS D1.5 Code

AWS D1.1 Structal Welding Code - AASHTO D1.5 Bridge Welding Code

AASHTO/AWSD1.5M/D1.5:2015
Bridge Welding Code

AWS D1.1/D1.1M:2015
Structural Welding Code
Steel

Items Covered by AWS D1.1 Code.

- The Structural Welding Code - Steel provides welding requirements for the construction of steel structures.

- There are approximately 62 different classifications of base metal approved for welding in the AWS D1.1 Code.

Items Covered by AWS D1.5 Code - Continued

- The Bridge Welding Code covers welding fabrication requirements applicable to both shop and field fabrication of steel bridges and bridge components.

- There are 7 different classifications of base metal approved for welding in the AWS D1.5 Code.

Limitations of AWS D1.5 Code – Clause 1.

The Code is not intended to be used for the following:

1) Pressure vessels or pressure piping.

2) Structures composed of Structural Tubing.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 2 Design

- No major differences between the AWS D1.1 and AWS D1.5 Codes in Clause 2 except as noted below.

- AWS D1.5 Design Requirements are covered by AASHTO documents and are not included in the AWS D1.5 Code.
- AWS D1.1 covers Tubular Joint Design but AWS D1.5 does not.

Differences Between AWS D1.1 and AWS D1.5 Codes – General Comment

- The Titles of the Clauses identified in both the AWS D1.1 Code and the AWS D1.5 Code are not exactly the same but both Codes basically cover the same topics.

Differences Between AWS D1.1 and AWS D1.5

Codes – Clause 3 – 5

- In **AWS D1.1 Clause 3 - Prequalification of WPSs**

  SMAW, FCAW, GMAW, SAW and GTAW welding processes are all prequalified.

- In **AWS D1.5 Clause 5 – Qualification**
- SMAW is the only welding process that is prequalified. All other welding processes must be qualified by PQR Testing.

Differences Between AWS D1.1 and AWS D1.5

Codes – Clause 4 – 5

- In AWS D1.1 Procedure Qualification Tests requires the following:

1) Root and Face or Side Bends.
2) Reduced Section Tensile Test.
3) Charpy Impact requirements are required only if specified in the Contract Documents.
4) Macroetch Tests for Partial Penetration Welds.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 4 -- 5

- In AWS D1.5 Procedure Qualification Tests requires the following:

1) Macroetch Tests.
2) Side Bends.
3) Reduced Section Tensile Test.
4) All-Weld-Metal Tension Test.
5) Charpy Impact Tests.
6) Root and Face or Side Bends.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 6 Inspection

- The AWS D1.1 Code only requires Visual Inspection

- The AWS D1.5 Code requires the following NDE inspections:

1) Visual
2) Magnetic Particle
3) Radiographic
4) Ultrasonic Testing

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 6 Inspection

- AWS D1.5 allows Phased Array Ultrasonic Inspection to be substituted for conventional UT using the procedure and acceptance requirements specified in the Code.

- AWS D1.1 does not allow Phased Array Ultrasonic Inspection except as a specific PAUT Procedure developed by the Contractor as described in **Annex Q – UT Examination of Welds by Alternate Techniques**.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 7 Stud Welding

- There are no major differences between the AWS D1.1 and AWS D1.5 Codes in Clause 7 – Stud Welding.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 8

- In the AWS D1.1 Code addresses statically loaded structures throughout.

- In the AWS D1.5 Code Clause 8 is titled Statically Loaded Structures and them states “No Applications Within The Code”.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 9 -- 10

- In the AWS D1.1 Code Clause 9 covers Tubular Structures.

- In the AWS D1.5 Code Clause 10 is titled Tubular Structures and it states “No Application Within This Code”.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 12 - Fracture Control Plan

- AWS D1.5 Fracture Control Plan is to be used when the member or member component is identified as Fracture Critical by the Engineer.

- Fracture critical members or member components are tension members or tension components of bending members the failure of which would be expected to result in collapse of the bridge

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 12 - Fracture Control Plan – Con't

- Members and components that are not subject to tensile stress under any condition of live load shall not be defined as fracture critical.

- AWS D1.1 does not have a Fracture Control Plan.

Differences Between AWS D1.1 and AWS D1.5 Codes – Clause 12 - Fracture Control Plan - Con't

- Fracture Critical Code Commentary

- **C12.1 General Provisions** The Fracture Control Plan should not be used indiscriminately by designers as a crutch "to be safe" and to circumvent good engineering practice.

Thank You