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API Ballot 7127 TG LP

Work Item Number	4265
Title of Work Item	5L Repair Welding
Ballot Revision Level	0
Type of Ballot (Initial, Comment, Comment resolution (reference API ballot#), 1 st Re-ballot, 2 nd Re-ballot, etc.)	Initial Work Item Ballot [WG Comments attached]
Submitter Name(s)	Bill Walsh
API Document Modified	API Spec 5L, 47 th Edition
Impacted Documents	API Spec 5L, 47 th Edition
Revision Key	Current API document in black, Additions in red with <u>underline</u> Deletion in blue with strikethrough

Work Item Charge: It is proposed to incorporate additional requirements for pipe seam repair welding for API 5L based. This may result in modifications to existing sections in API 5L and/or new annex material. The additional requirements are to be considered based on published industry specifications (e.g. IOGP S-616) and standards (e.g. API 1104 and ASME BPVC Section IX) as well as best practices shared by suppliers. Considerations include welding consumables, essential variables, repair restrictions, and qualification of procedures and welders.

Ballot Rationale: There are good practices in industry amongst suppliers in repair welding beyond what is captured in API 5L C.4 and annex D. It is noted that many purchaser specifications include requirements on repair welding.

Implementing standard practices to control repair welding improves integrity of installed pipelines.

Ballot Text: See bellow

Annex C (normative)

Treatment of Surface Imperfections and Defects

C.1 Treatment of Surface Imperfections

Surface imperfections not classified as defects may remain in the pipe without repair or may be cosmetically dressed-out by grinding.

C.2 Treatment of Dressable Surface Defects

C.2.1 All dressable surface defects shall be dressed-out by grinding.

C.2.2 Grinding shall be carried out in such a way that the dressed area blends in smoothly with the contour of the pipe.

C.2.3 Complete removal of defects shall be verified by local visual inspection, aided, where necessary, by suitable nondestructive inspection methods. To be acceptable, the wall thickness in the ground area shall be in accordance with 9.11.3.2; however, the minus tolerances for diameter and out-of-roundness (see 9.11.3.1) shall not apply in the ground area.

C.3 Treatment of Nondressable Surface Defects

Pipe that contains nondressable surface defects shall be given one or more of the following dispositions:

- a) weld defects in SAW and COW pipe shall be repaired by welding in accordance with C.4;
- b) the sections of pipe containing the surface defects shall be cut off, within the limits on length; or
- c) the entire pipe length shall be rejected.

C.4 Repair of Defects by Welding

~~C.4.1 For PSL 1 pipe only, repair of the pipe body by welding is permitted. For PSL 2 pipe, repair of the pipe body by welding is not permitted.~~

C.4.1 Permitted Repairs

For PSL 1 pipe only, repair of the SAW, COW and pipe body by welding is permitted, but repair of seam welds made without filler metal is not permitted. For PSL 2 pipe, repair of the SAW and COW by welding is permitted, but repair of the pipe body or seam welds made without filler metal is not permitted. The type of weld repair allowances for the imperfections to be weld repaired, the repair dimensions, and distance between repairs, are presented in Table C.1.

~~C.4.3 The total length of repaired zones on each pipe weld shall be $\leq 5\%$ of the total weld length for SAW and COW weld seams. For coil/plate end welds, the total length of the repaired zone shall not exceed 100 mm (4.0 in.) and shall not be within 100 mm (4.0 in.) of the junction between the end weld and the helical seam weld.~~

~~C.4.4 Weld defects separated by less than 100 mm (4.0 in.) shall be repaired as a continuous single weld repair. Each single repair shall be carried out with a minimum of two layers/passes over a length of at least 50 mm (2.0 in.).~~

Table C.1 – Welding Repair Allowances

Clause	Action	Weld Type		
		Weld Seam	Jointer	Coil/Plate End
<u>1</u>	<u>Welds Containing Cracks</u>	<u>Not Permitted</u>		
<u>2</u>	<u>Through Thickness Repairs</u>	<u>Not Permitted</u>		
<u>3</u>	<u>Minimum Distance Between Adjacent Weld Repairs</u>	<u>100 mm (4.0 in)</u>		
<u>4</u>	<u>Maximum Distance Between Defects Requiring Repair as a Continuous Single Weld</u>	<u>100 mm (4.0 in)</u>		
<u>5</u>	<u>Minimum Length of Repair</u>	<u>50 mm (2.0 in)</u>	<u>No Limit</u>	
<u>6</u>	<u>Maximum Length of Individual Repair Weld</u>	<u>350 mm (13.8 in)</u>	<u>less than or equal to 12% of weld length</u>	<u>100 mm (4.0 in).</u>
<u>7</u>	<u>Total Length of Cumulative Weld Repair</u>	<u>less than or equal to 5% of weld length</u>	<u>less than or equal to 25% of weld length</u>	<u>100 mm (4.0 in)</u>
<u>8</u>	<u>Minimum Distance from End of Weld Repair to Helical Seam</u>	<u>Not Applicable</u>	<u>Not Applicable</u>	<u>100 mm (4.0 in)</u>
<u>9</u>	<u>Repair of Weld Area Previously Repaired</u>	<u>At each location, permitted only once without qualified Welding Procedure, permitted only twice with a qualified Repair Welding Procedure</u>		
<u>10</u>	<u>Minimum Distance from</u>	<u>200 mm (7.9 in)</u>	<u>Not Applicable</u>	<u>Not Applicable</u>

	<u>End of Repair to End of Pipe</u>		
<u>11</u>	<u>Maximum Number of Repairs</u>	<u>4 per pipe, or average of 1 weld repair per 3 m (10 ft) of weld</u>	<u>For OD greater than and equal to 508 mm (20 in), maximum of two repairs; For OD less than 508 mm (20 in), maximum of one repair</u>
<u>12</u>	<u>Maximum Extent of Weld Repair into the Parent Metal for PSL2 Pipe</u>	<u>3.2 mm (0.125 in) (See Figure C.1)</u>	

~~C.4.2 Except as allowed by C.4.1, repair by welding shall be confined to the weld of SAW and GOW pipe. The defect shall be completely removed and the resulting cavity shall be thoroughly cleaned. For PSL 2 pipe, the rim of the resulting cavity shall not extend into the parent metal by more than 3.2 mm (0.125 in.), as measured along the pipe surface perpendicular to the weld (see Figure C.1). Unless otherwise agreed, repairs to welds in cold-expanded PSL 2 pipe shall have been performed prior to cold expansion. Seam welds made without filler metal shall not be repaired by welding.~~

C.4.2 Defect Removal

The defect shall be completely removed and the resulting cavity shall be thoroughly cleaned. When arc-air gouging is used for defect removal, grinding shall be carried out for the removal of the decarburized zone.

C.4.3 Cold Expansion

Unless otherwise agreed, repairs to welds in cold-expanded PSL 2 pipe shall have been performed prior to cold expansion.

C.4.4 Weld Procedure

Weld repairs shall be performed using a welding procedure that is qualified in accordance with Annex D.

C.4.5 Uniform Appearance

The external surface of the repair weld shall be subjected to grinding to obtain a uniform appearance and to merge smoothly into the base material.

~~C.4.6 After weld repair, the total area of the repair shall be ultrasonically or radiographically inspected in accordance with Annex E and, if applicable, Annex K. Before expansion or hydrotest, the type of ultrasonic testing (UT) may be at the option of the pipe manufacturer; however, after expansion or hydrotest, inspection shall be by manual UT. It would also be acceptable to carry out combined automatic and manual UT after expansion or hydrotest.~~

C.4.6 NDT

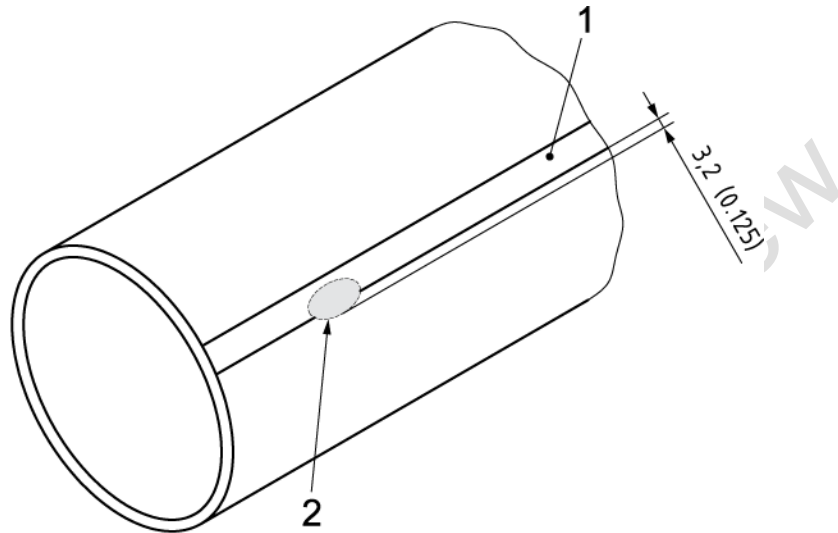
The repaired area shall be examined by the original method of NDT that indicated the defect, and after hydrotest, the repaired area shall be examined by automatic UT. If agreed, manual UT may be substituted for automatic UT after hydrotest. NDT coverage of weld repairs shall extend at least 50 mm (2.0 in) beyond end of each weld repair.

C.4.7 SMLS

For SMLS pipe (PSL 1 only), prior to weld repair, magnetic particle testing (MT) or penetrant testing (PT) inspection shall be performed to ensure complete removal of defect.

C.4.8 Hydrostatic Test

Pipe that has been repair welded shall be hydrostatically tested after repair welding in accordance with 10.2.6.



Key

- 1 weld reinforcement
- 2 rim of resultant cavity

Figure C.1—Resultant Cavity of Weld Repair (PSL 2 Only)

Annex D (normative)

Repair Welding Procedure

D.1 General

D.1.1 Repair welds shall be made:

- a) with the pipe axis being in the horizontal plane,
- b) in accordance with a qualified welding procedure, and
- c) by a welding machine operator (hereafter called operator) or repair welder who is qualified in accordance with D.3.

~~D.2.1.3 For the purpose of this annex, the term “automatic welding” includes machine welding, mechanized welding, and automatic welding.~~

D.1.2 Automatic Welding

For the purpose of this annex, the term “automatic welding” includes machine welding, mechanized welding, and automatic welding.

D.1.23 Welding Process

Repair welds shall be made by one or more of the following ~~methods~~ processes:

- a) automatic submerged arc,
- b) automatic or semi-automatic gas metal arc, or
- c) manual shielded metal arc using low-hydrogen electrodes.

D.1.34 Storage

All welding materials shall be properly handled and stored in accordance with the manufacturer's recommendations, so as to preclude moisture or other contamination.

D.1.45 Product Form

Test welds shall be made on strip, plate, or pipe. For repair weld WPS required in Annexes H, J, or N, the test welds must be made on the seam of a pipe product form, as shown in Figure D.2 (b) and (c) and D.3 (a) and (b).

D.1.56 Record

The manufacturer shall maintain a record of the welding procedure and the procedure qualification test results. Copies of the WPS and the welding procedure qualification record shall be provided to the purchaser upon request.

D.2 Repair Welding Procedure Qualification

D.2.1 General

~~D.2.1.1 Welding procedures shall be qualified by preparing and testing welds in accordance with this annex, except as allowed by D.2.1.2.~~

D.2.1.4 Types of Repairs

Welding procedures specifications (WPS) shall be qualified by preparing and testing welds in accordance with this annex, except as allowed by D.2.1.2.3.

D.2.1.1 Major Repair

Weld repairs performed to a maximum depth of $\frac{3}{4}t$ are classified as a major repair and shall require a qualified WPS. Major repair WPS are required for weld seam, jointer, and coil/plate-end weld types.

D.2.1.2 Minor Repair

If agreed, an additional weld repair WPS can be qualified for a maximum depth of $\frac{1}{4}t$, classified as a minor repair. The minor repair WPS requires a two pass minimum, and can be qualified for weld seam, jointer, and coil/plate-end weld types.

D.2.1.3 Repair of Flux/Wire Stop

If agreed, a repair WPS can be qualified for flux/wire-stop occurrences. A flux/wire-stop WPS can be qualified for weld seam, jointer, and coil/plate-end weld types.

D.2.1.4 Multiple Repairs

If agreed, a multiple repair WPS can be qualified for a weld area previously repaired. If multiple repair qualification is not performed, only a single repair at each location shall be permitted. If multiple repair qualification is performed, a maximum of two weld repairs at each location shall be permitted. A multiple repair WPS can be qualified for weld seam, jointer, and coil/plate-end weld types.

D.2.2 Essential Variables

An existing procedure shall not be applicable and a new procedure shall be qualified if any of the following essential variables is changed beyond the stated limits in Table D.1.

~~a) Welding process:~~

- ~~1) a change in the welding process, such as submerged arc to gas metal arc, or~~
- ~~2) a change in the method, such as manual to semi-automatic.~~

~~b) Pipe material:~~

- ~~1) a change in pipe grade category; if different alloying systems are used within one pipe grade category, each alloying composition shall be separately qualified, wherein pipe grade categories are as follows:~~
 - ~~i) pipe Grade $\leq$ L290 or X42,~~

- ~~ii) pipe Grade $> \text{L290}$ or X42 , and pipe Grade $< \text{L450}$ or X65 ,~~
 - ~~iii) each pipe Grade $\geq \text{Grade L450}$ or X65 ;~~
- ~~2) within each pipe grade category, a thicker material than the material qualified;~~
- ~~3) within the pipe grade category and thickness range, a carbon equivalent (CE_{Mn} if the carbon mass fraction is greater than 0.12 % and CE_{Pcm} if the carbon mass fraction is less than or equal to 0.12 %), based on product analysis for the material to be repaired, that is more than 0.03 % greater than the carbon equivalent of the material qualified; or~~
- ~~4) change in delivery condition (see Table 3);~~
- ~~c) Welding materials:~~
 - ~~1) change in the filler metal classification;~~
 - ~~2) when impact tests are required, a change in the consumable brand name;~~
 - ~~3) change in the electrode diameter;~~
 - ~~4) change in the composition, X , of the shielding gas of more than $(X \pm 5)$ %;~~
 - ~~5) change in the flow rate, q , of the shielding gas of more than $(q \pm 10)$ %; or~~
 - ~~6) change in submerged arc welding flux from one designation to another.~~
- ~~d) Welding parameters:~~
 - ~~1) change in the type of current (such as from alternating current to direct current);~~
 - ~~2) change in polarity;~~
 - ~~3) for automatic and semi-automatic welding, the ranges of welding current, voltage, speed, and heat input may be established to cover ranges of wall thickness. Within the range, appropriately selected points shall be tested to qualify the entire range. Thereafter, a new qualification is required if there is a deviation from the qualified range greater than one or more of the following:~~
 - ~~i) 10 % in amperage;~~
 - ~~ii) 7 % in voltage;~~
 - ~~iii) 10 % in travel speed for automatic welding;~~
 - ~~iv) 10 % in heat input; or~~
 - ~~4) any increase in groove depth, a , over that qualified. The depth of groove shall be set by the manufacturer, unless otherwise agreed.~~
- ~~e) Weld bead: for manual and semi-automatic welding, a change in bead width greater than 50 %;~~
- ~~f) Preheat and post-weld heat treatment:~~
 - ~~1) repair welding at a pipe temperature lower than the pipe temperature of the qualification test, or~~

2) ~~the addition or deletion of post weld heat treatment.~~

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Table D.1 Repair Welding Essential Variables

<u>Clause</u>	<u>Sub-clause</u>	<u>Type</u>	<u>Essential Variable</u>
<u>1</u>	<u>1.1</u>	<u>Welding Process</u>	<u>A change between submerged arc, gas metal arc, or manual shielded metal arc</u>
	<u>1.2</u>		<u>A change between automated, semi-automated or manual welding processes</u>
<u>2</u>	<u>2.1</u>	<u>Parent Material</u>	<u>For carbon mass fraction greater than 0.12% using CE IIW, a change in carbon equivalent greater than +0.03 % based on heat analysis as well as those with lower CE IIW</u>
	<u>2.2</u>		<u>For carbon mass fraction less than or equal to 0.12% using CE Pcm, a change in carbon equivalent greater than +0.03 % based on heat analysis as well as those with lower CE Pcm</u>
<u>3</u>	<u>3.1</u>	<u>Pipe Grade</u>	<u>For grades less than X52, a higher grade shall qualify that grade and all lower grades</u>
	<u>3.2</u>		<u>For grade X52 to X56, one grade qualifies both</u>
	<u>3.3</u>		<u>For grades X60 and above, each grade requires separate qualification</u>
<u>4</u>	<u>4.1</u>	<u>Nominal Wall Thickness</u>	<u>Wall thickness used qualifies all thinner wall thicknesses</u>
<u>5</u>	<u>5.1</u>	<u>Delivery Condition</u>	<u>A change in delivery condition</u>
<u>6</u>	<u>6.1</u>	<u>Welding Consumables</u>	<u>A change in filler metal classification</u>
	<u>6.2</u>		<u>A change in consumable brand name when impact tests are required</u>
	<u>6.3</u>		<u>A change in electrode diameter</u>
	<u>6.4</u>		<u>A change in the composition, X, of the shielding gas of more than $(X \pm 5) \%$</u>
	<u>6.5</u>		<u>A change in the flow rate, q, of the shielding gas of more than $(q \pm 10) \%$</u>
	<u>6.6</u>		<u>A change in submerged arc flux designation</u>
<u>7</u>	<u>7.1</u>	<u>Welding Parameters</u>	<u>A change in current type (from direct to alternating or vice versa)</u>
	<u>7.2</u>		<u>A change in polarity</u>

	<u>7.3</u>		<u>A change of more than +/- 10% of the automatic or semi-automatic qualified current (ΔA)</u>
	<u>7.4</u>		<u>A change of more than +/- 7% of the automatic or semi-automatic qualified voltage (ΔV)</u>
	<u>7.5</u>		<u>A change of more than +/- 10% of the automatic or semi-automatic qualified travel speed (ΔS)</u>
	<u>7.6</u>		<u>A change of more than +/- 10% of the automatic or semi-automatic qualified heat input (ΔJ)</u>
<u>8</u>	<u>8.1</u>	<u>Weld Groove</u>	<u>An increase in the qualified groove depth (a)</u>
<u>9</u>	<u>9.1</u>	<u>Weld Bead</u>	<u>An increase in the qualified manual or semi-automatic weld bead width (w) more than 50%</u>
<u>10</u>	<u>10.1</u>	<u>Preheat and Post-Weld Heat Treatment</u>	<u>A decrease in the qualified preheat temperature during repair</u>
	<u>10.2</u>		<u>A any addition or deletion from the qualified post-weld heat treatment</u>

D.2.3 Mechanical Testing

At the option of the manufacturer, the welding procedure qualification mechanical tests specified in ISO 15614-1 ^[23], API 5L 43rd Edition ^[47] or ASME Section IX ^[26] may be substituted for those specified in D.2.3.

D.2.3.1 Number of Test Pieces

Two test pieces for each type of test (see D.2.3.2 and D.2.3.3) shall be prepared and tested for each welding procedure qualification test. For impact testing, three test pieces for each location shall be prepared and tested (see D.2.3.4). For hardness testing, one test piece shall be prepared and tested (see D.2.3.5).

D.2.3.2 Transverse Tensile Test

D.2.3.2.1 The reduced width of transverse tensile test pieces shall be 38 mm (1.5 in.) and the repair weld shall be at the mid-length of the test piece, as shown in Figure 8 a). The weld reinforcement shall be removed from both faces and the longitudinal edges shall be machine cut.

NOTE Although Figure 8 a) shows a guided-bend test specimen, it is referred to for guidance of where the repair weld is to be located for a tensile specimen.

D.2.3.2.2 The tensile strength shall be at least equal to the minimum specified for the applicable pipe grade.

D.2.3.3 Transverse Guided-bend Test

D.2.3.3.1 The transverse guided-bend test pieces shall be as shown in Figure D.1, with the weld having been made in a groove.

D.2.3.3.2 Each test piece shall be bent 180° in a jig (see Figure 9 and Table D.4.2), with the exposed surface of the weld in tension.

D.2.3.3.3 Except as allowed by D.2.3.3.4, the bend test shall be considered acceptable if no crack or other defect exceeding 3.2 mm (0.125 in.) in any direction is present in the weld metal or base metal after bending.

D.2.3.3.4 Cracks that occur at the edges of the test piece during testing shall not be cause for rejection, provided that they are not longer than 6.4 mm (0.250 in.).

D.2.3.4 Charpy (CVN) Impact Test

D.2.3.4.1 Charpy impact test pieces shall be taken from weld-repaired areas of repair welding procedure qualification tests (see D.2.1.4).

D.2.3.4.2 Charpy test pieces shall be prepared in accordance with the requirements of 10.2.3.3 of this specification.

D.2.3.4.3 The CVN impact test shall be carried out in accordance with the requirements of 9.8 and 10.2.4.3 of this specification.

D.2.3.4.4 The minimum average absorbed energy (of a set of three test pieces) for each repaired pipe weld and its associated HAZ, based on full-size test pieces and a test temperature of 0 °C (32 °F) or, if agreed, a lower test temperature, shall be not less than that specified in 9.8.3 for the pipe seam weld metal and HAZ, or a higher energy if agreed.

Where pipe dimensions do not permit the preparation and testing of full-size CVN test pieces from repair welding procedure qualification tests and sub-size CVN test pieces are used, the requirements of 10.2.3.3 and Table 22 shall apply.

D.2.3.4.5 Sampling of CVN specimens shall be performed at the locations represented in Figure D.2 (a) for a major repair type weld (see D.2.1.1). For CVN testing specified in Annex H, J, or N, the CVN specimens shall be performed at the locations represented in Figure D.2 (b) for major repairs (Table D.1.1) and Figure D.2 (c) for minor repairs (Table D.1.2).

D.2.3.5 D.2.3.5 Hardness Testing

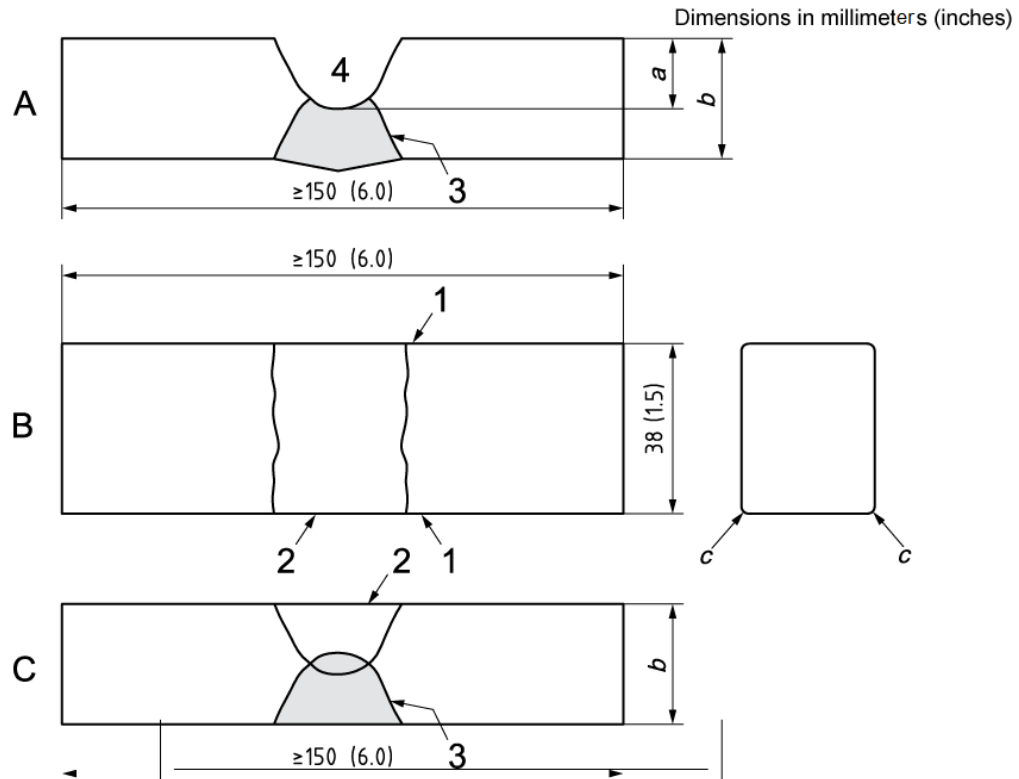
D.2.3.5.1 If hardness testing (HV10) is specified for the SAW or COW weld, hardness testing shall in addition be performed on repairs to the SAW and COW weld.

D.2.3.5.2 Unless the spacing of the governing testing specification deems otherwise, the number and position of the indentations shall be in accordance with Figure D.3 (a) for major repair qualification. For hardness testing specified in Annex H, J, or N, the indentations shall be performed at the locations represented in Figure D.3 (b) for major repairs (Table D.1.1) and Figure D.3 (c) for minor repairs (Table D.1.2). Where indentations spacing in accordance with Figure D.3 (a) (b) or (c) are too small (see ISO 6507-1 or ASTM E92/ASTM E384), the number of indents shall be by agreement.

D.2.3.5.4 Acceptance criteria shall be in accordance with the applicable annexes, or as agreed.

D.2.4 NDT of Weld Repair Procedure Qualification Test

The weld repair procedure qualification test piece shall be inspected in accordance with E.3, by using either the radiographic inspection technique in accordance with E.4 or the ultrasonic inspection technique in accordance with E.5 or a combination of both techniques. The weld-repaired area shall meet the same acceptance criteria specified in E.4.5 and/or E.5.5 as appropriate.



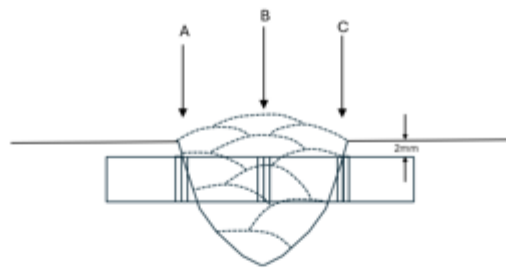
Key

- A before repair welding – Section view
- B after repair welding – Plan view
- C after repair welding – Section view
- 1 longitudinal edges machined, cold sawn, thermally cut, or any combination thereof
- 2 repair weld metal with weld reinforcement removed
- 3 pre-existing SAW/COW weld (if applicable) with weld reinforcement removed
- 4 repair groove
- a Groove depth.
- b Wall thickness (see D.2.2 b) 2).
- c The radius, r , shall be less than or equal to 1.6 (0.063).

Figure D.1—Guided-bend Test Piece

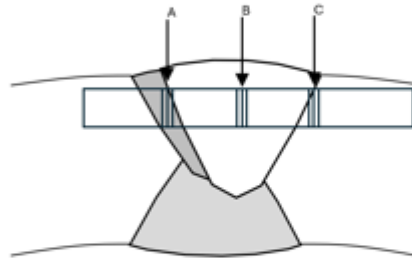
Table D.42—Guided-bend Test Jig Dimensions

Pipe Grade	Dimension ^a mm (in.)			
	r_a^b	r_b^b	A_{gb}^b	B^b
≤ L290 or X42	$3.0t$	$4.0t + 1.6 (0.063)$	$6.0t$	$8.0t + 3.2 (0.125)$
L320 or X46	$3.5t$	$4.5t + 1.6 (0.063)$	$7.0t$	$9.0t + 3.2 (0.125)$
L360 or X52	$4.0t$	$5.0t + 1.6 (0.063)$	$8.0t$	$10.0t + 3.2 (0.125)$
L390 or X56	$4.0t$	$5.0t + 1.6 (0.063)$	$8.0t$	$10.0t + 3.2 (0.125)$
L415 or X60	$4.5t$	$5.5t + 1.6 (0.063)$	$9.0t$	$11.0t + 3.2 (0.125)$
L450 or X65	$4.5t$	$5.5t + 1.6 (0.063)$	$9.0t$	$11.0t + 3.2 (0.125)$
L485 or X70	$5.0t$	$6.0t + 1.6 (0.063)$	$10.0t$	$12.0t + 3.2 (0.125)$
L555 or X80	$5.0t$	$6.0t + 1.6 (0.063)$	$10.0t$	$12.0t + 3.2 (0.125)$
L620 or X90	$5.5t$	$6.5t + 1.6 (0.063)$	$11.0t$	$13.0t + 3.2 (0.125)$
L690 or X100	$6.0t$	$7.0t + 1.6 (0.063)$	$12.0t$	$14.0t + 3.2 (0.125)$
L830 or X120	$7.0t$	$8.0t + 1.6 (0.063)$	$14.0t$	$16.0t + 3.2 (0.125)$
^a For intermediate grades, the dimensions shall be as specified for the next lower grade, or shall be obtained by interpolation.				
^b r_a , r_b , A_{gb} , and B are as shown in Figure 9.				

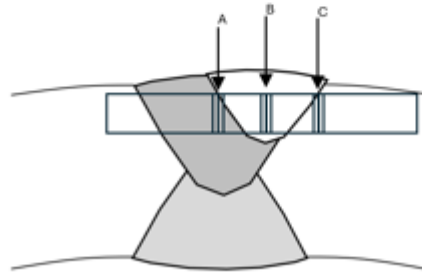


Note: Number of passes is dependent on WPS
on WPS and wall thickness

- A = HAZ into original SAW metal
 - B = Repair Weld Centerline
 - C = HAZ into parent metal
- (a) Major Repair Weld Charpy Locations

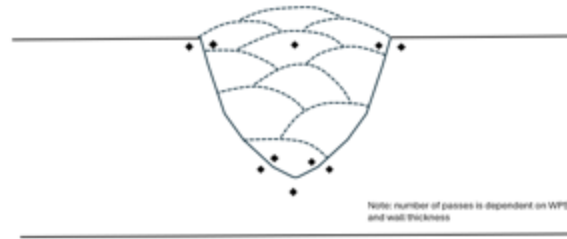


- A = HAZ into original SAW metal
 - B = Repair Weld Centerline
 - C = HAZ into parent metal
- (b) Major Repair Weld Charpy Locations,
Annex H, J, and N

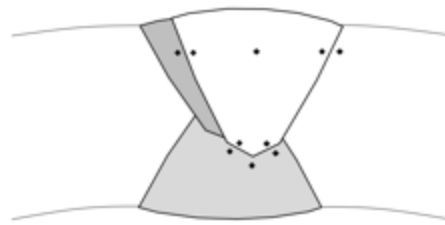


- A = HAZ into original SAW metal
 - B = Repair Weld Centerline
 - C = HAZ into parent metal
- (c) Minor Repair Weld Charpy Locations,
Annex H, J, and N

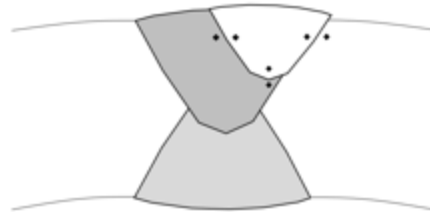
Figure D.2—Weld Repair Charpy Sampling Locations



(a) Major Repair Weld Hardness Indentation Locations



(b) Major Repair Weld Hardness Indentation Locations, Annex H, J, and N



(c) Minor Repair Weld Hardness Indentation Locations, Annex H, J, and N

Figure D.3—Weld Repair Hardness Indentation Locations

D.3 Welding Personnel Performance Qualification

D.3.1 Qualification

D.3.1.1 General

Each repair welder and operator shall be qualified according to the requirements of this section. Alternatively, at the option of the manufacturer, welders and operators may be qualified to ISO 9606-1 [25], ASME Section IX [26], API 5L 43rd Edition [17], Appendix C, or EN 287-1 [24].

A repair welder or operator qualified on one pipe grade category [see D.2.2 b)] is qualified for any lower pipe grade category, provided that the same welding process is used.

D.3.1.2 Inspection

To qualify, a repair welder or operator shall produce welds that are acceptable by inspection as follows:

- a) film radiographic inspection in accordance with Annex E,
- b) two transverse guided-bend tests (see D.2.3.3).

D.3.1.3 Inspection Failures

If one or more of the inspections in D.3.1.2 fail to meet the specified requirements, the welder or operator may make one additional qualification weld. If that weld fails one or more of the inspections in D.3.1.2, the welder or operator is disqualified. No further retests shall be permitted until the welder has completed additional training.

D.3.2 Re-qualification

Re-qualification in accordance with D.3.1 shall be required if one or more of the following applies:

- a) one year has elapsed since the last prior applicable qualification;
- b) the welder or operator has not been welding using qualified procedures for a period of 3 months or more; or
- c) there is reason to question the welder's or operator's ability.

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