API 1104 - Standard for Welding of Pipelines
Updates from the 21st Edition Committee

Southwest Gas Corporation
Mike Childers
Specialist
(Operations Staff/Corporate Engineering)
• History – The first API 1104 was published back in 1953

• Distribution – The Number one selling, and most widely used Industry Standard in the World.

• U.S. Federal Regulation: (PHMSA) – IBR: Sections 5, 6, 9, & A (All of A if used, not mandated to follow A) (No other Sections are being considered for IBR at this time).

• Current Published Edition: The 21st Edition, Published September 2013

• Proposed IBR of the 21st Edition – 2015
Majority of Cross-Country Pipelines are required to use the API 1104 (IBR Edition)

Over the past 61 years there have been dramatic changes in the development of higher strength steel for Pipe and Fitting materials, and the development of high-productivity mechanized welding equipment. Many new long-distance transmission pipelines are constructed today using high-strength steel materials and using high productivity mechanized welding equipment, for many of these large scale pipeline projects the girth welds are inspected using automated ultrasonic testing (AUT) equipment.
API 1104

Federal Requirements


§§192.225; 192.227(a); 192.229(c)(1); 192.241(c); Item II, Appendix B.

§192.225  Welding procedures – Section 5

§192.227  Qualification of welders – Section 6

§192.229  Limitations on welders – Section 6 or 9

§192.241  Inspection and test of welds —Section 9 or A
API 1104

Authors

• Committee Members— Representatives from the Oil & Natural Gas Industry.
• API/AGA Committee Voting Members- Consists of 28 appointed Subject Matter Experts (SME’s) from seven categories, four from each: API, AGA, Pipeline Contractors Association, Pipe Manufacturers, American Society for Nondestructive Testing, American Welding Society, and General Interest.

Subcommittees:

• Fracture Mechanics
• Maintenance Welding
• Mechanized Welding
• Nondestructive Testing
• Repair Welding Task Group

• Modification, Interpretation & Policy
• Welding Procedures & Welder Qualification
• General Interest Members
• 21st Edition Editorial Group
# API Ballot Summary Sheet

**Ballot:** API 1104 - Addendum 1  
**Start Date:** 4/4/14  
**Closing Date:** 5/16/14  
**Associate:** Edmund Baniak  
**Coordinator:** Edmund Baniak  

## Proposal:

### Voting Category

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API Ballot Summary Sheet  
5/23/2014  
Ballot: API 1104 - Addendum 1  
Ballot ID: 3224  
Associate: Edmund Baniak  
Coordinator: Edmund Baniak  
Start Date: 4/4/14  
Closing Date: 5/16/14  
Proposal: 

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| Total Responses: | 26 |
| Total Ballots:   | 28 |
| Response Rate ((Affirmative + Negative + Abstain) / Total Ballots): | 93% |
| Approval Rate (Affirmative / [Affirmative + Negative]) | 100% |
| Consensus:       | YES |

Must be > 50%
Must be >= 66.66%
### API 1104

#### Review of Comments

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<td>1</td>
<td>Addison, Ryan</td>
<td>Affirmative</td>
<td>Figure b.4</td>
<td>Figure b.4</td>
<td>General</td>
<td>Removal of Note 1 is agreed, however, no mention of avoiding thermal cutting methods is mentioned.</td>
<td>Suggest including comment to avoid thermal cutting methods.</td>
<td>Disagree: The use of thermal cutting (overized, followed by machining using a nonthermal process) is addressed in B.2.5.4.1 for the Macrosection test and in B.2.5.5.1 for the Face Bend test. The use of thermal cutting is allowed for the Nick-Break test (B.2.3.1). Specimen preparation details are not included in figures similar to B.4 [i.e., suggested location of test specimen figures] in the standard.</td>
<td></td>
<td>Tenaris Coiled Tubes, LLC/Downtele Facility</td>
<td><a href="mailto:raddison@tenaris.com">raddison@tenaris.com</a></td>
<td>1-281-458-2089</td>
<td>USA</td>
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<td>Addison, Ryan</td>
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<td>Figure b.4</td>
<td>Note 2</td>
<td>General</td>
<td>There does not appear to be a benefit in removing the size call outs of Note 2. A minimum size needs to be stated, keeping in mind the required tests. Otherwise the requirements for specimen preparation potentially won’t be met as per 5.6 or 5.8.</td>
<td>Suggest retaining the information of Note 2 somewhere within the Figure in some way.</td>
<td>Disagree: Specimen size is addressed in B.2.5.4.1 for the Macrosection test, B.2.5.5.1 for the Face Bend test, and 5.6.3.1 for the Nick-Break test. Specimen dimensions are not included in figures similar to B.4 (i.e., suggested location of test specimen figures) in the standard.</td>
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<td>Tenaris Coiled Tubes, LLC/Downtele Facility</td>
<td><a href="mailto:raddison@tenaris.com">raddison@tenaris.com</a></td>
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<td>The subject is not in the area of my expertise.</td>
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<td>Noted. No propose changes identified by commenter.</td>
<td></td>
<td>CRES (Center for Reliable Energy Systems)</td>
<td><a href="mailto:nwang@cres-americas.com">nwang@cres-americas.com</a></td>
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<td>United States</td>
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API 1104
Addendum / Errata

• Errata issued as needed — No Ballot

• Addenda (changes) Proposed, as needed—Ballot

• Changes can be new additions (section or annex) or revision to existing text.

• API posts all Addendum and Errata (free)

API 1104

Addendum / Errata

Pipeline Transportation Addenda/Errata Publications

Errata 5, March 2014

Addendum 1, July 2014
Errata 3, July 2014

RP 1109, Marking Liquid Petroleum Pipeline Facilities, Fourth Edition, October 2010
Errata, November 2010

Errata, July 2007

RP 1117, Recommended Practice for Movement of In-service Pipelines, 3rd Edition, July 2008
Errata 1, December 2008
Errata 2, August 2009

Errata 1, September 2013

RP 1101, Recommended Practice for Pipeline Operator Qualification
Updated Covered Task Lists

Errata, December 2005
ERRATA 3

Page 12, Section 5.3.2.3, second sentence, replace:

Groupings are shown in 6.2.2 d) and 6.2.2 e).

with

Examples of suggested groupings are shown in 6.2.2 d) and 6.2.2 e).

Page 27, Figure 12, replace the figure:

NOTE: HAZ hardness impressions shall be entirely within the heat-affected zone and located as close as possible to the fusion boundary (between the weld metal and the heat-affected zone).

Page 57, Section 11.1.5, replace the NOTE with:

NOTE: For purposes of IQI selection, when the SWE/SWV or DWE/DWV technique is used, the thickness of the weld means the specified wall thickness plus the weld reinforcement (internal plus external combined). When the "elliptical" DWE/DWV technique is used, the thickness of the weld means twice the specified wall thickness plus the single weld reinforcement (internal plus external combined). When the "superimposed" DWE/DWV technique is used, the thickness of the weld means twice the specified wall thickness plus twice the weld reinforcement (internal plus external combined).

Page 85, Section A.3.3, replace:

...multiple pipe materials as defined by A.3.1 b) may...

with

...multiple pipe materials as defined by A.3.2 b) may...

Page 90, delete Section A.3.4.4.

Page 103, Section B.1, 8th paragraph (continued from previous page), replace the second sentence:

The previously mentioned thermal analysis computer models or other proven...

with

The previously mentioned thermal analysis computer models or other proven...

Page 103, Section B.2.2.1.1, delete the second paragraph.
Page 105, Figure B.2, replace the value on the arrow:

45, 5

with

45° ±5°

Page 105, Figure B.2, NOTE, replace:

NOTE  This test position qualifies the procedure for all positions. Tests may be performed in other positions that qualify the procedure for that position only.

with

NOTE  For a single in-service welder qualification, this test qualifies the welder for all positions. Tests may be performed in other positions which will qualify the welder for that position only.

Page 109, Section B.2.5.5.2, second sentence, replace:

The face bend specimens should be bent in a guided-bend test jig similar to that shown in Figure 9.

with

The face bend specimens should be bent in a guided-bend test jig similar to that shown in Figure 8.

Page 110, Figure B.6, NOTE 1, replace:

Test specimens may be machine cut or oxygen cute oversized and machined (see B.2.4.5.1).

with

Test specimens may be machine cut or oxygen cut oversized and machined (see B.2.5.5.1).
Proposed Addendum 1 - Technical Changes to API 1104, Figure B.4

1104 (Welding of Pipelines and Related Facilities)

Current Figure B.4

Key:
FR = face bend test specimen
MT = macrosection and hardness test specimen
SB = side bend test specimen
NB = Nick break test specimen

NOTE 1: Test specimens are machined out or obtained by other nonthermal cutting processes. Cut surfaces need to be smooth and parallel. The weld surfaces need to be ground smooth and flush with the pipe surface.

NOTE 2: Test specimens are prepared in accordance with the requirements of 10.3.7.2.

NOTE 3: Face bend and side bend test specimens are positioned in the pulsed-bend test [p] such a manner that the tested bend zone is placed in tension.
API 1104
Revisions and Interpretations

- API 1104 is revised regularly (*every five years) to adapt to changing pipeline construction practices. In spite of these revisions, there are many requirements in API 1104 that are subject to interpretation. (Official Interpretations of the API 1104 can only come from the API 1104 Interpretations Committee, and/or API Staff.

- Interpretations/Modifications Subcommittee was dissolved and replaced with the Interpretations Task Group (ITG)

- ITG Membership includes Committee Leadership and the Subcommittee Co-chairs.

- Chair of the 1104 is the Chair of the ITG (unless delegated)

- ITG meets 2-4 times per year, as needed, to reply to Interpretations Requests. Face-to-Face Meeting not Needed.

- ITG addressed the time lag from Submission of Interpretations Request to Issuance of the Interpretation (some issues took over a year)

- ITG will Meet at the 1104 Meeting Annually
API 1104

- **Annex C** - Requests for Interpretation and Request for Revision to the Document.
- Must follow all requirements of Annex C
- Only Interpretations of the API 1104
- Not designed to provide technical Welding consultation.

Standards Department
API
1220 L Street, NW
Washington, DC 20005
Standards@API.org
API 1104 Definitions

- **Shall**: As used in a standard, “shall” denotes a minimum requirement in order to conform to the specification. (API definition)

- **Should**: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the specification. (API definition)
API 1104

Contents

1) Scope
2) Normative References
3) Terms, Definitions, Acronyms, and Abbreviations
4) Specifications
5) Qualification of Welding Procedures with Filler Metal Additions
6) Qualification of Welders
7) Design and Preparation of a Joint for Production Welding
8) Inspection and Testing of Production Welds
9) Acceptance Standards for NDT
10) Repair and Removal of Weld Defects
11) Procedures for Nondestructive Testing
12) Mechanized Welding with Filler Metal Additions
13) Automatic Welding Without Filler Metal Additions

Annex A—Alternative Acceptance Standards for Girth Welds
Annex B—In-service Welding
Annex C—Request for Interpretation and Request for Revision to the Document
3.2 Acronyms and Abbreviations

For the purposes of this standard, the following acronyms and abbreviations apply:

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<tr>
<th>Acronym</th>
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<td>$A$</td>
<td>welding current (amp)</td>
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<td>imperfection height (in. or mm)</td>
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<tr>
<td>AC</td>
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<td>AI</td>
<td>accumulation of imperfections</td>
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<td>$d_n$</td>
<td>$J$ integral to CTOD conversion factor (unitless)</td>
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API 1104

**Abbreviations:**
- **DWV**: double-wall viewing
- **DP**: pipe diameter-to-wall thickness ratio
- **E**: Young's modulus (ksi or MPa)
- **ECA**: engineering critical assessment
- **ESI**: elongated slag inclusion
- **EU**: undercutting adjacent to the cover pass
- **EW**: electric resistance or electric induction weld
- **FAC**: failure assessment curve
- **FAD**: failure assessment diagram
- **HAZ**: heat-affected zone
- **HB**: hollow bead porosity
- **H₂S**: hydrogen sulfide
- **IC**: internal concavity
- **ICP**: inadequate cross penetration
- **ID**: inside diameter
- **IF**: incomplete fusion
- **IFD**: inadequate fusion due to cold lap
- **IP**: inadequate penetration without high-low
- **IPD**: inadequate penetration due to high-low
- **IQI**: image quality indicator
- **ISI**: isolated slag inclusion
- **IU**: undercutting adjacent to root pass
- **J**: heat input (pulses per in.)
- **J₀**: elastic part of J integral (ksi in. or MPa mm)
- **k**: total number of cyclic stress levels
- **Kf**: stress intensity factor (ksi in.¹/₂ or MPa (mm)¹/₂)
- **K₁**: toughness ratio in FAD format (unitless)
- **LB**: linear burned
- **L₀**: stress ratio in FAD format (unitless)
- **L₁₃₅°**: cutoff stress ratio in FAD format (unitless)
- **LS**: linear surface
- **κ₋**: toughness ratio
- **Mn**: manganese
- **Mo**: molybdenum
- **MPS**: manufacturing procedure specification
- **NDT**: nondestructive testing
- **n**: strain hardening exponent (unitless)
- **Ni**: nickel
- **N₀**: number of cycles at the nth cyclic stress level
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<th>Abbreviation</th>
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<td>OD</td>
<td>outside diameter</td>
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<td>( P_f )</td>
<td>normalized applied stress or load level, ( P_f = \sigma_f/\sigma_t ) (unitless)</td>
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<td>PWHT</td>
<td>postweld heat treatment</td>
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<tr>
<td>( J )</td>
<td>welding arc speed (in. per minute)</td>
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<td>( S^* )</td>
<td>is the spectrum severity</td>
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<td>submerged-arc helical weld</td>
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<td>SAWL</td>
<td>submerged-arc longitudinal weld</td>
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<tr>
<td>SCC</td>
<td>stress corrosion cracking</td>
</tr>
<tr>
<td>SMTS</td>
<td>specified minimum tensile strength</td>
</tr>
<tr>
<td>SMYS</td>
<td>specified minimum yield strength</td>
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<tr>
<td>( \sigma_r )</td>
<td>stress ratio</td>
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<tr>
<td>SWE</td>
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<td>single-wall viewing</td>
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<td>( t_s )</td>
<td>specified pipe wall thickness (in. or mm)</td>
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<td>( T )</td>
<td>transverse</td>
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<tr>
<td>TCG</td>
<td>time-corrected gain</td>
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<tr>
<td>( V )</td>
<td>vanadium</td>
</tr>
<tr>
<td>( W )</td>
<td>welding arc voltage (volt)</td>
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<tr>
<td>VC</td>
<td>volumetric cluster</td>
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<tr>
<td>( V_{II} )</td>
<td>volumetric individual</td>
</tr>
<tr>
<td>VR</td>
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<td>WT</td>
<td>wall thickness</td>
</tr>
<tr>
<td>( Y/T )</td>
<td>yield-to-tensile ratio</td>
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<tr>
<td>( \alpha )</td>
<td>ratio of pipe diameter to wall thickness, ( \alpha = D/t ) (unitless)</td>
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<tr>
<td>( \beta )</td>
<td>ratio of imperfection length to pipe circumference, ( \beta = 2\eta D ) (unitless)</td>
</tr>
<tr>
<td>( \Delta \sigma_t )</td>
<td>in cyclic stress range, in kips per in.(^2) (ksi)</td>
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<tr>
<td>( \Delta \sigma_e )</td>
<td>elastic part of CTOD (in. or mm)</td>
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<tr>
<td>( \delta_{\text{max}} )</td>
<td>CTOD toughness (in. or mm)</td>
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<td>( \epsilon_u )</td>
<td>uniform strain (unitless)</td>
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<tr>
<td>( \eta )</td>
<td>ratio of imperfection height to pipe wall thickness, ( \eta = a/h ) (unitless)</td>
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<tr>
<td>( \nu )</td>
<td>Poisson's ratio (unitless)</td>
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<tr>
<td>( \pi )</td>
<td>pi</td>
</tr>
<tr>
<td>( \sigma_{\text{ax}} )</td>
<td>maximum axial design stress (ksi or MPa)</td>
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<tr>
<td>( \sigma_c )</td>
<td>plastic collapse stress (ksi or MPa)</td>
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<tr>
<td>( \sigma_f )</td>
<td>flow stress of the pipe material (ksi or MPa)</td>
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<tr>
<td>( \sigma_{\text{UT}} )</td>
<td>ultimate tensile strength of the pipe material (ksi or MPa)</td>
</tr>
<tr>
<td>( \sigma_{\text{YS}} )</td>
<td>specified minimum yield strength of the pipe material, or SMYS, (ksi or MPa)</td>
</tr>
</tbody>
</table>
4.2 Materials

4.2.1 Pipe and Piping Components

This standard applies to the welding of pipe and piping components that conform to material and product specifications including, but not limited to:

a) API specifications,

b) ASME International specifications,

c) ASTM International specifications,

d) Manufacturers Standardization Society (MSS) specifications,


This standard also applies to materials with chemical and mechanical properties that comply with one of the specifications listed in Items a) through e) above, even though the material is not manufactured in accordance with the specification.

4.2.2 Filler Metals and Fluxes

4.2.2.1 Types

All filler metals and fluxes shall conform to one of the following, except as provided below:

a) AWS A5.1,

b) AWS A5.2,

c) AWS A5.5,

d) AWS A5.17,

e) AWS A5.18,

f) AWS A5.20,

g) AWS A5.23,

h) AWS A5.28,

i) AWS A5.29.

Filler metals and fluxes that do not conform to the specifications above may be used provided the welding procedure specifications involving their use are qualified.
5 Qualification of Welding Procedures with Filler Metal Additions

5.1 Procedure Qualification

This section applies to the qualification of welding procedures using manual welding and semiautomatic welding using filler metal additions. Section 12 applies to the qualification of welding procedures using mechanized welding with filler metal additions. Section 13 applies to the qualification of welding procedures for automatic welding without filler metal additions. When a welding procedure specification uses a combination of manual/semiautomatic and mechanized welding, the requirements of Section 5 and Section 12 apply to their portions of the welding procedure specification.

Before production welding is started, a detailed welding procedure specification shall be established and qualified to demonstrate that welds with suitable mechanical properties (such as strength, ductility, and hardness) and soundness can be made by the procedure. The quality of the welds shall be determined by destructive testing. These procedures shall be adhered to except where a change is specifically authorized by the company, as provided for in 5.4.

5.2 Record

The details of each qualified procedure shall be recorded. The record shall show complete results of the procedure qualification test. Forms similar to those shown in Figure 1 and Figure 2 should be used. The record shall be maintained as long as the procedure is in use.

5.3 Welding Procedure Specification

5.3.1 General

The welding procedure specification shall include the information specified in 5.3.2 where applicable.

5.3.2 Specification Information

5.3.2.1 Process

The specific process, method of application, or combination thereof shall be identified.
5.3.2.13 Preheat and Postweld Heat Treatment (PWHT)
Preheat and PWHT shall be as follows:

a) for preheat, the methods, minimum temperature at the start of the weld, and minimum ambient temperature below which preheat is required shall be specified;

b) for PWHT, the methods, minimum and maximum temperature, time at temperature, and temperature control methods for PWHT shall be specified.

5.3.2.14 Shielding Gas and Flow Rate
The composition of the shielding gas and the range of flow rates shall be designated.

5.3.2.15 Shielding Flux
The type of shielding flux shall be designated.

5.3.2.16 Speed of Travel
The range for speed of travel, in in. (mm) per minute, shall be specified for each pass.

5.3.2.17 Method of Cooling After Welding
If forced cooling is to be used, the specification shall designate the type of cooling after welding, such as forced cooling with water, as well as the maximum metal temperature at which forced cooling is applied.
5.4.2.2  Base Material

A change in base material constitutes an essential variable. When welding materials of two separate material groups, the procedure for the higher strength group shall be used. For the purposes of this standard, all materials shall be grouped as follows:

a)  SMYS less than or equal to that of the material specified as API 5L Grade X42;

b)  SMYS greater than that of the material specified as API 5L Grade X42 but less than that of the material specified as API 5L Grade X65;

c)  for materials with a SMYS greater than or equal to that of the material specified as API 5L Grade X65, each grade shall receive a separate qualification test.

NOTE 1  The groupings specified in 5.4.2.2 do not imply that base materials or filler metals of different analyses within a group may be indiscriminately substituted for a material that was used in the qualification test without consideration of the compatibility of the base materials and filler metals from the standpoint of metallurgical and mechanical properties and requirements for preheat and PWHT.

NOTE 2  When base material with multiple grade markings is being used, the company designates, before using the material, the selected single grade to be used.
<table>
<thead>
<tr>
<th>Group</th>
<th>AWS Specification</th>
<th>AWS Classification Electrode</th>
<th>Flux</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A5.1</td>
<td>E6010, E6011</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A5.5</td>
<td>E7010, E7011</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A5.5</td>
<td>E6010, E6011, E9010</td>
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</tr>
<tr>
<td>3</td>
<td>A5.1 or A5.5</td>
<td>E7015, E7016, E7018</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A5.5</td>
<td>E6015, E6016, E8018</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E9018</td>
<td></td>
</tr>
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<td>4  a</td>
<td>A5.17</td>
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<td>F6XZ</td>
</tr>
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<td></td>
<td></td>
<td>EL8K</td>
<td>F6X0</td>
</tr>
<tr>
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<td>EM5K</td>
<td>F7XZ</td>
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<td>EM12K</td>
<td>F7X0</td>
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<td></td>
<td></td>
<td>EM13K</td>
<td>F7X2</td>
</tr>
<tr>
<td>5  b</td>
<td>A5.18</td>
<td>ER70S-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A5.18</td>
<td>ER70S-6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A5.28</td>
<td>ER80S-D2</td>
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<td></td>
<td>A5.28</td>
<td>ER80S-G</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>A5.2</td>
<td>RG60, RG65</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>A5.20</td>
<td>E61T-GS d</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E71T-GS d</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>A5.29</td>
<td>E71T8-K8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A5.29</td>
<td>E91T8-G</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
Other electrodes, filler metals, and fluxes may be used but require separate procedure qualification.

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* Any combination of flux and electrode in Group 4 may be used to qualify a procedure. The combination is identified by its complete AWS classification number, such as F7A0-EL12 or F6A2-EM12K. Only substitutions that result in the same AWS classification number are permitted without requalification.

* A shielding gas (see 5.4.2.10) is required for use with the electrodes in Group 5.

* In the flux designation, the X can be either an A or P for as-welded or postweld heat treated.

* For root pass welding only.
5.6.2 Tensile Strength Test

5.6.2.1 Preparation

The full-thickness tensile strength test specimens shall be either of the types shown in Figure 4.

a) The standard specimens shall be prepared as shown in Figure 4 a). They may be machine cut or oxygen cut, and no other preparation is needed unless the sides are notched or are not parallel. If necessary, the specimens shall be machined so that the sides are smooth and parallel.

b) The reduced section specimens shall be prepared as shown in Figure 4 b). The weld reinforcement may be removed.
5.6.3.3 Requirements

The exposed surfaces of each nick break specimen shall show complete penetration and fusion. The greatest dimension of any gas pocket shall not exceed 1/8 in. (1.6 mm), and the combined area of all gas pockets shall not exceed 2% of the exposed surface area. Slag inclusions shall not be more than 1/32 in. (0.8 mm) in depth and shall not be more than 1/8 in. (3 mm) or one-half the specified wall thickness in length, whichever is smaller. There shall be at least 1/2 in. (13 mm) separation between adjacent slag inclusions of any size. The dimensions should be measured as shown in Figure 6. Fisheyes, as defined in AWS A3.0, are not cause for rejection.

For a test weld diameter greater than 12 3/4 in. (323.9 mm), if only one nick break specimen fails, then the specimen may be replaced by two additional nick break specimens from locations near to the failed specimen. If either of the replacement nick break specimens fail, the weld is considered unacceptable.
Figure 5—Nick Break Test Specimen

5.6.4 Root and Face Bend Test

5.6.4.1 Preparation

The root and face bend test specimens (see Figure 7) shall be approximately 9 in. (230 mm) long and approximately 1 in. (25 mm) wide, and their long edges shall be rounded. They may be machine cut or oxygen cut. The cover and root bead reinforcements shall be removed flush with the surfaces of the specimen. These surfaces shall be smooth, and any scratches that exist shall be light and transverse to the weld. [The specimen shall not be flattened prior to testing.]

5.6.4.2 Method

The root and face bend specimens shall be bent in a guided-bend test jig similar to that shown in Figure 8. Each specimen shall be placed on the die with the weld at midspan. Face bend specimens shall be placed with the face of the weld toward the gap, and root bend specimens shall be placed with the root of the weld toward the gap. The plunger shall be forced into the gap until the curvature of the specimen is approximately U shaped. Alternate best test fixtures with bend radii equal to or less than the radius specified in Figure 8 may be used at the discretion of the company.
Figure 7—Root and Face Bend Test Specimen: Wall Thicknesses Less Than or Equal to 0.500 in. (12.7 mm)

5.6.4.3 Requirements

The bend test shall be considered acceptable if no crack or other imperfection exceeding 1/8 in. (3 mm) or one-half the specified wall thickness, whichever is smaller, in any direction is present in the weld or between the weld and the fusion zone after bending. Cracks that originate on the outer radius of the bend along the edges of the specimen during testing and that are less than 1/4 in. (6 mm), measured in any direction, shall not be considered unless obvious imperfections are observed. For test weld diameter greater than 12 3/4 in. (323.9 mm), if only one bend specimen fails, the specimen may be replaced with two additional specimens from locations adjacent to the failed specimen. If either of the replacement bend test specimens fails, the weld is considered unacceptable.
5.6.5 Side Bend Test

5.6.5.1 Preparation

The side bend test specimens (see Figure 9) shall be approximately 9 in. (230 mm) long and approximately 1/2 in. (13 mm) wide, and their long edges shall be rounded. They shall be machine cut, or they may be oxygen cut to approximately a 3/4 in. (19 mm) width and then machined or ground to the 1/2 in. (13 mm) width. The sides shall be smooth and parallel. The cover and root bead reinforcements shall be removed flush with the surfaces of the specimen.

5.6.5.2 Method

The side bend specimens shall be bent in a guided-bend test jig similar to that shown in Figure 8. Each specimen shall be placed on the die with the weld at midspan and with the face of the weld perpendicular to the gap. The plunger shall be forced into the gap until the curvature of the specimen is approximately U shaped. Alternate bend test fixtures with bend radii equal to or less than the radius specified in Figure 9 may be used at the discretion of the company.

5.6.5.3 Requirements

Each side bend specimen shall meet the root and face bend test requirements specified in 5.6.4.3. For test weld diameter greater than 12 3/4 in. (323.9 mm), a single failed side bend specimen may be replaced with two additional specimens from locations adjacent to the failed specimen. If either of the replacement bend test specimens fails, the weld is considered unacceptable.
6.3 Multiple Qualification

6.3.1 General

For multiple qualification, a welder shall successfully complete the two tests described below, using qualified procedures.

For the first test, the welder shall make a butt weld in the fixed position with the axis of the pipe either horizontal or inclined from horizontal at an angle of not more than 45°. This butt weld shall be made on pipe with an OD of at least 6.625 in. (168.3 mm) and with a wall thickness of at least 0.250 in. (6.4 mm) without a backing strip. The weld shall be acceptable if it meets the requirements of 6.4 and either 6.5 or 6.6. Specimens may be removed from the test weld at the locations shown in Figure 12, or they may be selected at the relative locations shown in Figure 12 but without reference to the top of the pipe, or they may be selected from locations that are spaced equidistantly around the entire pipe circumference. The sequence of adjacent specimen types shall be identical to that shown in Figure 12 for the various pipe diameters. Specimens shall not include the longitudinal weld.

For the second test, the welder shall lay out, cut, fit, and weld a branch-on-pipe connection in which the specified diameters of the run and the branch pipes are equal. This test shall be performed with a pipe diameter of at least
6.3.2 Scope

A welder who has successfully completed the butt weld qualification test described in 6.3.1 on pipe with an OD greater than or equal to 12.750 in. (323.9 mm) and a branch weld with pipe and branch having specified ODs greater than or equal to 12.750 in. (323.9 mm) in which the specified diameters of the run and branch pipes are equal shall be qualified to weld in all positions; on all wall thicknesses, joint designs, and fittings; and on all pipe diameters. A welder who has successfully completed the butt weld and branch weld requirements of 6.3.1 on pipe with an OD less than 12.750 in. (323.9 mm) shall be qualified to weld in all positions; on all wall thicknesses, joint designs, and fittings; and on all pipe ODs less than or equal to the OD used by the welder in the qualification tests.

If any of the following essential variables are changed in a welding procedure specification, the welder using the new procedure shall be requalified.

a) A change from one welding process to another welding process or combination of processes, as follows:

1) a change from one welding process to a different welding process; or

2) a change in the combination of welding processes, unless the welder has qualified on separate qualification tests, each using the same welding process that is used for the combination of welding processes.

b) A change in the direction of welding from vertical uphill to vertical downhill or vice versa.

c) A change of filler metal classification from Group 1 or 2 to any other group or from any Group 3 through 9 to Group 1 or 2 (see Table 1). A change of filler metal classification not listed in Table 1 to any other filler metal classification or vice versa.

6.4 Visual Examination

For a qualification test weld to meet the requirements for visual examination, the weld shall be free from cracks, inadequate penetration, and BT, and must present a neat workman-like appearance. The depth of undercutting adjacent to the final bead on the outside of the pipe shall not be more than $\frac{1}{32}$ in. (0.8 mm) or 12.5 % of the pipe wall thickness, whichever is smaller, and there shall not be more than 2 in. (50 mm) of undercutting in any continuous 12 in. (300 mm) length of weld.

When semiautomatic or mechanized welding is used, filler wire protruding into the inside of the pipe shall be kept to a minimum.

Failure to meet the requirements of this section shall be adequate cause to eliminate additional testing.
6.6.2 Inspection Requirements

When radiography is utilized, radiographs shall be made of each of the test welds. The welder shall be disqualified if any of the test welds do not meet the requirements of 9.3.

8.4.3 Vision Examinations

8.4.3.1 Near Distance

All NDT personnel shall be examined to ensure that they have natural or corrected near-distance acuity in at least one eye such that each individual is capable of reading Jaeger Number 1 test chart or equivalent at a distance of not less than 12 in.

8.4.3.2 Color Vision

NDT personnel for all methods shall demonstrate the ability to differentiate among the colors used in the method.

8.4.3.3 Frequency

Near vision examinations shall be administered at least annually. Color differentiation examinations shall be repeated at least every five years.
9.3.5 Incomplete Fusion Due to Cold Lap (IFD)

IFD is defined as an imperfection between two adjacent weld beads or between the weld metal and the base metal that is not open to the surface. This condition is shown schematically in Figure 17. IFD shall be considered a defect should any of the following conditions exist:

a) the length of an individual indication of IFD exceeds 2 in. (50 mm),

b) the aggregate length of indications of IFD in any continuous 12 in. (300 mm) length of weld exceeds 2 in. (50 mm),

c) the aggregate length of indications of IFD exceeds 8 % of the weld length.

9.3.6 Internal Concaivity (IC)

IC is defined in 3.1.13 and is shown schematically in Figure 18. Any length of IC is acceptable, provided the density of the radiographic image of the IC does not exceed that of the thinnest adjacent parent material. For areas that exceed the density of the thinnest adjacent parent material, the criteria for BT (see 9.3.7) are applicable.
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**Table 4—Maximum Dimensions of Undercutting**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1/32 in. (0.8 mm) or &gt;12.5 % of pipe wall thickness, whichever is smaller</td>
<td>Not acceptable</td>
</tr>
<tr>
<td>&gt;1/64 in. (0.4 mm) but ≤1/32 in. (0.8 mm) or &gt;8 % but ≤12.5 % of pipe wall thickness, whichever is smaller</td>
<td>2 in. (50 mm) in a continuous 12 in. (300 mm) weld length or one-sixth the weld length, whichever is smaller</td>
</tr>
<tr>
<td>≤1/64 in. (0.4 mm) or ≤8 % of pipe wall thickness, whichever is smaller</td>
<td>Acceptable, regardless of length</td>
</tr>
</tbody>
</table>

---

**10 Repair and Removal of Weld Defects**

**10.1 General**

Weld defects may be identified during visual or nondestructive testing, or during the company’s review of nondestructive testing results.

**10.2 Authorization for Repair**

**10.2.1 Company Authorization**

Company authorization is required for crack repairs, back weld repairs, and double repairs and as otherwise noted in 10.2. Company authorization is not required for any repairs that do not involve the application of heat or weld metal, such as grinding, filing, etc.
10.2.2 Crack Repairs
Cracked welds shall be cut out unless permitted by 9.3.10 or when the repair is authorized by the company. When a crack repair is authorized:

a) a cracked butt weld or branch weld may be repaired by complete or partial removal of the weld provided the length of a single crack or aggregate length of more than one crack in a single repair area is less than 8% of the weld length using a qualified repair procedure;

b) a cracked fillet weld may be repaired by complete or partial removal of the fillet weld using a qualified repair procedure.

c) a butt weld or branch weld that contains multiple repair areas with crack(s) may not be repaired unless the total accumulated repair length is less than 8% of the weld length and a qualified repair procedure is used;

d) a double repair of a crack is not permitted. Additional cracking in any weld after repair shall require a cut out.

e) shallow crater cracks or star cracks found and contained completely in internal or external weld reinforcement may be repaired by grinding (i.e. abrasive methods) without a qualified repair procedure. If the grinding exceeds the internal or external reinforcement, the reinforcement shall be replaced using a qualified weld procedure.

10.2.3 Repairs of Defects Other Than Cracks
Defects other than cracks in the root, filler, and finish beads may be repaired with prior company authorization. A qualified repair procedure shall be required whenever a repair is made by welding when:

a) using a welding process, combination of welding processes, or method of application or filler metals different from that used to make the original weld; or

b) repairs are made in a previously welded repaired area, or

c) required by the company.

10.2.4 Grinding Repairs
Grinding repairs may be used to remove defects in the reinforcement of root beads and cover passes provided:

— there is a smooth transition free of undercutting and other imperfections between the ground area and the original weld, and

— pipe surface contour and the minimum wall and weld thickness requirements are not violated.

If the minimum wall and weld thickness is not known, the grinding depth is limited to the excess root bead penetration of external reinforcement. The grinding repair length and number of grinding repair areas is not limited. Grinding repairs do not require use of a qualified repair procedure.

10.2.5 Back Weld Repairs
When back weld repairs are permitted by the company, a repair procedure shall be qualified in accordance with 10.3.
10.2.6 Welded Double Repairs

A double repair requires prior company authorization. For repair procedure qualification purposes, this is a partial thickness or full thickness repair that tests a HAZ that has received three full thermal cycles from welding. A grinding repair is not considered to be one of the thermal cycles.

NOTE: Subsequent repair of a double repair weld is not permitted unless specifically authorized by the by the company and repaired with a qualified procedure appropriate for the number of thermal cycles used. A qualified repair procedure for a double repair may be used for a single repair with prior company authorization.

10.2.7 Repair Area Length

10.2.7.1 Large Diameter Pipe

For pipe with a specified OD greater than or equal to 2.375 in. (60.3 mm), the length of an individual repair area or total length of accumulated repair areas within a completed weld for a partial thickness or full thickness repair shall not exceed a percentage of weld length determined by the company.

The length of an individual repair area or total length of accumulated repair areas determined by the company should be based on sound welding practice and/or engineering analysis of the installation stresses (i.e., combined axial and bending) and repair sequence for segmented repairs.

10.2.7.2 Small Diameter Pipe

For pipe with a specified OD less than 2.375 in. (60.3 mm), all repairs require company authorization.

10.2.7.3 Limit Increases

An increase in the specified individual or accumulated repair area length limits is subject to the discretion of the company.

10.2.8 Minimum Deposited Repair Weld Length

All repair welds shall have an individual deposited repair weld length of at least 2 in. (50 mm) or as otherwise specified by the company.

10.3 Repair Procedure

10.3.1 General

When a repair procedure is required, the procedure shall be established and qualified to demonstrate that a repair weld with suitable mechanical properties and soundness can be produced. The repair weld shall meet the minimum requirements of the production weld or as otherwise specified by the company.

10.3.2 Types of Repair Procedures

Types of repair procedures may include, but are not limited to, the following:

a) Full thickness repair;
b) Internal partial thickness repair;
c) External partial thickness repair;
d) Cover pass repair;
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10.3.3 Qualification

Repair procedures shall be qualified by visual and destructive testing. NDT may be required at the discretion of the company. For repair procedure qualification, sample preparation and destructive and nondestructive testing shall not commence until the repair weld has been allowed to cool to ambient temperature.

The minimum total number of specimens and the types of destructive tests to which each repair procedure shall be submitted are shown in Table 5. At the discretion of the company, additional types and number of tests may be required. When the production welding procedure was qualified with Charpy impact testing, Charpy impact testing shall also be performed to qualify partial thickness and full thickness repair procedures. As noted in Table 5, when wall thickness is over 0.500 in. (12.7 mm), the side bend tests shall be substituted for face bend or root bend tests.

NOTE: Depending on pipe material or welding process, the company may require additional cooling time prior to destructive and nondestructive testing.

Table 5—Type and Number of Butt Weld Test Specimens per Repair Type for Repair Procedure Qualification

<table>
<thead>
<tr>
<th>Repair Type</th>
<th>Tensile Strength</th>
<th>Nick Break</th>
<th>Root Bend</th>
<th>Face Bend</th>
<th>Side Bend</th>
<th>Macro/ Hardness</th>
<th>Charpy Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full thickness</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Internal partial thickness</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>External partial thickness</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Cover pass</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Blank weld</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

* Side bend tests are substituted for face bend or root bend tests when wall thickness is over 0.500 in. (12.7 mm).

10.3.4 Specification Information

A repair procedure, as a minimum, shall include the following:

a) Location and method for exploration of the defect(s)—Identify excavation location at either weld centerline and/or fusion line.

b) Method of defect removal—including method of inspection by which the repair groove shall be examined to confirm complete removal of the defect.

c) Requirements for preheat and interpass temperature—temperature (minimum/maximum), method of application, location, and extent shall be included.

d) Welding processes and other specification information contained in 5.3.2.

e) Procurement, if any, for interpass NDT.

f) Methods (i.e. storage, handling, usage) to control filler metals, fluxes, and shielding gases when hydrogen control is required per the manufacturer’s recommendations.

g) Repair type and repair procedure limitations.
h) Time delay, if any, before final inspection. The time delay specified in 10.3.3 is not required for repair welding.

10.3.5 Essential Variables

10.3.5.1 General

A repair procedure shall be reestablished as a new repair procedure and shall be requalified when any of the essential variables listed in 5.4.2 or the following are changed. Changes other than those given in 5.4.2 or below may be made without the need for requalification, provided the repair procedure is revised to show the changes.

10.3.5.2 Location of Excavation

Location changes requiring requalification are as follows:

a) a change from centerline to fusion line location for excavation of partial thickness repairs.

b) a change from centerline to fusion line location for cover pass repairs.

10.3.5.3 Type of Repair

Any change from a repair type listed in 10.3.2 to another, except when changing from a full thickness repair to either an internal or external partial thickness repair.

10.3.5.4 Preheat and Interpass Temperature

A decrease in the specified minimum preheat temperature used during repair procedure qualification. The addition or change in the interpass temperature requirements used to weld the test joint.

10.3.6 Welding of Test Joints

Repair procedures shall be qualified on a test weld completed following the details of the production welding procedure specification. The repair procedure shall be qualified in the fixed position on a segment of a full-circumference test weld for each repair type to be qualified in the location(s) specified by the company. The repair weld shall be a minimum of 8 in. (203 mm) in length to provide the necessary weld deposit length for destructive testing without Charpy impact tests. A single test joint may be used to qualify more than one type of repair procedure. Details for each repair procedure shall be recorded with the complete results and cross-sectional location of each repair. Qualification of repair procedures may be required in the presence of the company.

10.3.7 Testing of Repair Welds

10.3.7.1 Tensile, Nick Break, and Bend Tests

The test specimen preparation, test method, and acceptance requirements in 5.6 or 5.8 are appropriate for repair welds, except that test specimens shall be cut from the joint at each of the repair area locations. Weld reinforcement on tensile test specimens shall not be removed for cover pass repairs.

10.3.7.2 Macrosection/Hardness Tests

10.3.7.2.1 Preparation

Transverse sections shall be cut suitable for visual examination of the weld and adjacent base metal, and for a hardness survey. The transverse macrosections test specimens for hardness tests should be at least 1/2 in. (13 mm) wide. They may be machine cut, or they may be oxygen cut oversized and machined by a nonthermal process to remove at least 1/4 in. (6 mm) from the side(s) that will be prepared. For each macrosection test specimen, at least
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10.3.7.2 Visual Examination

The macrospecimens shall be visually examined with lighting that will sufficiently reveal the details of the weld soundness. The use of optical devices or dye penetrants is not necessary.

A visual examination of the macrospecimens shall show that the repair weld portion of the completed weld is completely fused to the adjacent base metal and/or weld metal at the root and between weld passes and is free of cracks. Any defects shall be within the applicable individual size limits specified in Section 9. If a cross section shows defects that are not associated with the repair weld portion of the completed weld, an additional cross section shall be evaluated. If the additional cross section contains other defects, the qualification test is unacceptable.

10.3.7.3 Hardness Testing

Macrosection test specimens shall be prepared for hardness testing in accordance with ASTM E364. The minimum required number of indentations shall be made using a Vickers indenter and a 10-kgf load, or less at locations shown in Figure 21 through Figure 26, or made at locations otherwise specified at the discretion of the company. HAZ hardness impressions shall be entirely within the HAZ and located as close as possible to the fusion boundary (between the weld metal and HAZ). If subsequent repairs (e.g., double repair) are qualified, the company shall provide hardness test locations.

Maximum hardness values for repair welds shall not exceed those given in Table 6 unless otherwise specified by the company.

NOTE: When hardness testing is required, chemical analysis is performed to determine the carbon equivalent of the base material.

Figure 21—Hardness Locations for Full Thickness Repair Procedure Qualification
10.3.7.4 Impact Tests
10.3.7.4.1 General
When required by 10.3.3, Charpy impact testing shall be performed at locations in the weld as specified by the company.

10.3.7.4.2 Preparation
For each repair procedure, both the weld metal and the HAZ shall be tested. Each test (of weld metal or HAZ) shall consist of at least three valid specimen tests performed at or below the minimum design temperature. The exact size of the specimens depends on the weld thickness but the largest possible size shall be selected. The specimens shall be machined, notched, and tested in accordance with ASTM E23. The notch shall be oriented in the through-thickness direction.
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Figure 24—Hardness Location for Back Weld Repair or Internal Partial Thickness Repair Procedure at Weld Centerline

Figure 25—Hardness Locations for Cover Pass Repair Procedure at Fusion Line

Figure 26—Hardness Locations for Partial Thickness Repair at Fusion Line
Table 6—Repair Weld Maximum Hardness Values, HV10

<table>
<thead>
<tr>
<th>Hardness Location</th>
<th>Weld Metal</th>
<th>Heat-affected Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Root and Midthickness</td>
<td>Cap</td>
</tr>
<tr>
<td>Sour service, any welding process</td>
<td>Note b</td>
<td>Note b</td>
</tr>
<tr>
<td>Non-sour service, any welding process</td>
<td>275</td>
<td>275</td>
</tr>
<tr>
<td>Non-sour service, low-hydrogen welding process</td>
<td>275</td>
<td>275</td>
</tr>
</tbody>
</table>

**Note:** The company may specify other maximum hardness values.

10.3.3.4.3 Requirements

The minimum average value and minimum individual value of impact energy for each set of three specimens when tested at the minimum design temperature shall not be less than the minimum values specified for qualification of the production weld or as otherwise specified by the company.

10.4 Repair Welder Qualification

10.4.1 General

The repair weld shall be made by a qualified welder experienced in methods used for repair of a defective weld. The welder shall be qualified according to the requirements of 6.2 or 6.3 in addition to the requirements of this section.

When a repair procedure is required by 10.2, a welder shall be qualified using the applicable qualified repair procedure. Welders shall be qualified using a completed weld to make a repair weld following all the details of the repair procedure. The repair weld shall be deposited in the fixed position on a segment of a full-circumference test weld for each repair type to be qualified (in the locations) specified by the company. The repair weld shall be a minimum of 8 in. (203 mm) in length to provide the necessary weld deposit for destructive testing. A single completed weld may be used to qualify more than one type of repair.

Details of the repair welder qualification shall be recorded and maintained with the complete results of the qualification test for each type and location of repair to meet the requirements of 6.8.

10.4.2 Testing of Repairs

For a repair welder qualification test weld, the repair weld shall meet the visual examination requirements of 6.4 and 10.3.7.2.

The destructive testing requirements in 6.5 are for qualification of a repair welder, except that test specimens shall be cut from the joint at each individual repair area location for each type of repair. The total number of specimens and the test to which each shall be submitted are shown in Table 7. As noted in Table 7, when wall thickness is over 0.500 in. (12.7 mm), the side bend tests shall be substituted for face bend or root bend tests.

A welder who fails to pass the repair welder qualification test(s) shall be permitted to retest as described in 6.7.
Table 7—Type and Number of Butt Weld Test Specimens per Repair Type for Repair Welder Qualification

<table>
<thead>
<tr>
<th>Repair Type</th>
<th>Tensile Strength</th>
<th>Nick Break</th>
<th>Root Bend</th>
<th>Face Bend</th>
<th>Side Bend</th>
<th>Total (Minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full thickness</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Internal partial thickness</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>External partial thickness</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Coverpass</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Back weld</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

* Side bend tests are substituted for face bend or root bend tests when wall thickness is over 0.500 in. (12.7 mm).
* One nick break specimen is taken at the transition between the repair weld end and original weld bead and the second nick break specimen located at the midpoint of the repair weld deposit.

10.4.3 Qualification Limits

A repair welder who has successfully completed the qualification test described in 10.4.3 shall be qualified within the limits of the essential variables described below. If any of the following essential variables are changed, the repair welder using a repair procedure shall be requalified:

a) any change from one repair type to another, except when changing from a full thickness repair to any partial thickness repair;

b) a change in filler metal group (see Table 1);

c) an increase in depth of the repair area greater than two times the deposited repair weld thickness in the repair welder qualification test;

d) a change in position from that for which the repair welder has already qualified (e.g., a change from flat to vertical or a change from vertical to horizontal or vice versa), except overhead position qualifies for all positions.

10.5 Supervision

The repair shall be made under the supervision of an individual acceptable to the company who is experienced and knowledgeable in methods and procedures used for repairs.

Inspection of repairs shall be performed as specified by the company. Welding inspection personnel shall meet the requirements of 8.3.

Repairs shall be documented and maintained by the company.

10.6 Acceptance Criteria

Repairs shall be inspected and evaluated by the same NDT methods previously used to determine a defect. Visual inspection is considered adequate when the defect was rejected by visual means and repaired by grinding without additional welding. NDT of a repair weld includes as a minimum the total repair area plus 10% of the total repair weld length or 2 in. (50 mm), whichever is longer on each side of the repair area. Repairs shall be considered acceptable when the repair area meets the standards of acceptability of Section 9 or more stringent acceptance criteria specified by the company.

NOTE: A repair weld of a weld originally inspected and rejected using alternative acceptance criteria derived in accordance with Annex A must be reinspection and meet the standards of acceptability of Section 9 or more stringent acceptance criteria as
12 Mechanized Welding with Filler Metal Additions

12.1 Acceptable Processes

Mechanized welding shall be performed using one or more of the following processes:

a) submerged arc welding,
b) gas metal arc welding,
c) gas tungsten arc welding,
d) flux-cored arc welding with or without external shielding,
e) plasma arc welding,
f) the use of a manual or semiautomatic process combined with one of the mechanized processes listed in this section.
12.4.2.2 Materials

The materials to which the procedure applies shall be identified. Materials may be grouped (see 5.4.2.2), provided that the qualification test is made on the material with the highest SMYS in the group.

12.12 Ultrasonic Testing

Ultrasonic testing shall be in accordance with 11.4.
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• Section 13 – No significant changes to Flash Butt-welding.

• Annex A – New Essential Variables Chemical Composition Chart. More descriptive language.

• Annex B – (Guidance for Weld deposition repair WDR, Bill Bruce & Bill Amend)
  (W.A. Bruce and W.E. Amend, “Guidelines for Pipeline Repair by Direct Deposition of Weld Metal,” WTIA/APIA Welded Pipeline Symposium, Welding Technology Institute of Australia, Sydney, Australia, April 3, 2009.)

• Annex C – New Annex. Request for Interpretation and Request for Revision to the Document
Several new referenced documents.
Harmonized language, and terminology with other API, and Industry recognized Standards
Added Several Acronyms and Abbreviations
Repair procedures, terminology, and definitions.
Forced cooling requirements (Section 5)
Base Material Descriptions and new Note:
New format for the Tables
Reduced Section Tensile Strength Test Specimen requirements (Section 5)
Alternate (smaller) bend radius permitted for bend test
Welder Qualification test specimens cannot contain the longitudinal weld (Section 6)
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Review Continued

- Requirement for Vision Examinations of all NDT personnel (Section 8.4.3)
- Repair of Cracks and Defects other than cracks.
- Qualification of Weld Repair Procedures
- Repair Welder Qualification
- Note for proper IQI selection for each process SWE/SWV, DWE/SWV or DWE/DWV.
- Ultrasonic Testing for Mechanized Welding
- Annex B – (Guidance for Weld deposition repair WDR, Bill Bruce & Bill Amend)
  (W.A. Bruce and W.E. Amend, “Guidelines for Pipeline Repair by Direct Deposition of Weld Metal,” WTIA/APIA Welded Pipeline Symposium, Welding Technology Institute of Australia, Sydney, Australia, April 3, 2009.)
- New Annex C - Request for Interpretation and Request for Revision to the Document
Thank you.
Questions?