Changes in the 21st Edition of API 1104

Outline

- Introduction
- Timeline
- What the IBR Means
- What Has Changed?
- Application to WUA Procedures
- Questions

Introduction

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- Pipeline Safety Engineer with the PSC
- I was previously a steel and welding focused pipeline consultant
- I have 5 pets, two of which are pigeons

Timeline


20th Edition is Finalized
December 2008
21st Edition is Finalized
September 2018
21st Edition is IBR'd into CFR 192
April 2024
April 2009
20th Edition is IBR'd into CFR 192
July 2021
22nd Edition is Published
January 2025
Stay of Enforcement Ended on 21st Edition

What the IBR Means

The IBR Does Mean…

- All **newly qualified** welding procedures (WPSs) must be qualified under the 21st edition of 1104,
- **New** welder qualifications and requalifications must be done to the 21st edition,
- API 1104 must be followed when referenced in the CFR,

But…

- **Previously qualified** WPSs can use prior editions of 1104.
- **Existing** welders with **no lapse** per CFR 192.229 do not need to requalify.
- Only Sections 5, 6, 9, 12, Annex A and Annex B are referenced in the CFR.

What Has Changed? Section 5

Section 5

Qualification of Welding Procedures with Filler Metal Additions

What Has Changed? Section 5.3

5.3: Welding Procedure Specification	
5.3.2.5	Filler Metal, **Flux**, and Number of Beads: Added a flux designation requirement. Implication of this is that electrodes with a G (general) designation now need to have manufacturer and trade name specified.
5.3.2.6	Electrical Characteristics: "The current and polarity shall be designated, and the range of voltage and amperage for each **type and size** of electrode, rod, or wire shall be shown."
5.3.2.13	Preheat and Postweld Heat Treatment (PWHT): This change expands on what needs to be specified in the procedures regarding temperatures for preheat treatment as well as post-weld heat treatment.
5.3.2.17	Method of Cooling After Welding: Completely new section. "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."

What Has Changed? 5.3.2.13

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5.3.2.13 Pre- and Post-heat Treatment

The methods, temperature, temperature-control methods, and ambient temperature range for pre- and post-heat treatment shall be specified (see 7.11).

21st Edition

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.

What Has Changed? Section 5.4

5.4: Essential Variables	
5.4.2.2	Base Material: Grades are per API 5L not a specific psi value. Note 2 is excluded from the IBR.
5.4.2.6	Filler Metal: A change in G suffix designator manufacturer or trade name is now an essential variable.
5.4.2.10	Shielding Gas & Flow Rate: The vague word "major" was changed to "**greater than 20% of the nominal flow rate**“ to indicate what constitutes a change in essential variable.

What Has Changed? 5.4.2.2

20th Edition

a. Specified minimum yield strength less than or equal to 42,000 psi (290 MPa).

b. Specified minimum yield strength greater than 42,000 psi (290 MPa) but less than 65,000 psi (448 MPa).

c. For materials with a specified minimum yield strength greater than or equal to 65,000 psi (448 MPa), each grade shall receive a separate qualification test.

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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.

5L

Pipe Grade	Pipe Body of Seamless and Welded Pipe			Weld Seam of EW, LW, SAW, and COW Pipe
	Yield Strength [a] $R_{t0.5}$ MPa (psi) min	Tensile Strength [a] R_m MPa (psi) min	Elongation (on 50 mm or 2 in.) A_f % min	Tensile Strength [b] R_m MPa (psi) min
L175 or A25	175 (25,400)	310 (45,000)	[c]	310 (45,000)
L175P or A25P	175 (25,400)	310 (45,000)	[c]	310 (45,000)
L210 or A	210 (30,500)	335 (48,600)	[c]	335 (48,600)
L245 or B	245 (35,500)	415 (60,200)	[c]	415 (60,200)
L290 or X42	290 (42,100)	415 (60,200)	[c]	415 (60,200)
L320 or X46	320 (46,400)	435 (63,100)	[c]	435 (63,100)
L360 or X52	360 (52,200)	460 (66,700)	[c]	460 (66,700)
L390 or X56	390 (56,600)	490 (71,100)	[c]	490 (71,100)
L415 or X60	415 (60,200)	520 (75,400)	[c]	520 (75,400)
L450 or X65	450 (65,300)	535 (77,600)	[c]	535 (77,600)
L485 or X70	485 (70,300)	570 (82,700)	[c]	570 (82,700)

What Has Changed? 5.4.2.2 Note 2

§ 192.225 Welding procedures.

(a) Welding must be performed by a qualified welder or welding operator in accordance with welding procedures qualified under section 5 (except for Note 2 in section 5.4.2.2), section 12, Appendix A or Appendix B of API Std 1104 (incorporated by reference, *see* § 192.7), or section IX of the

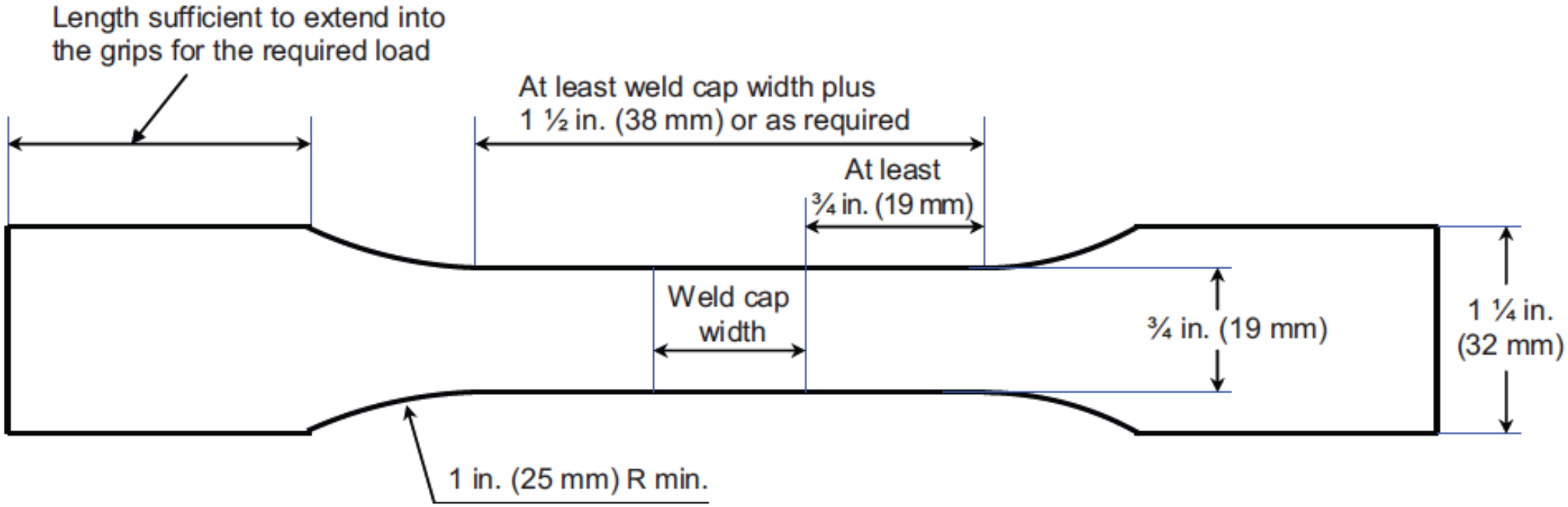
b) SMYS greater than that of the material specified as API 5L Grade X42 but less than that of the material specified as API 5L Grade X65;

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 mate[illegible] before using the material, the selected single grade to be [illegible]

What Has Changed? Section 5.6



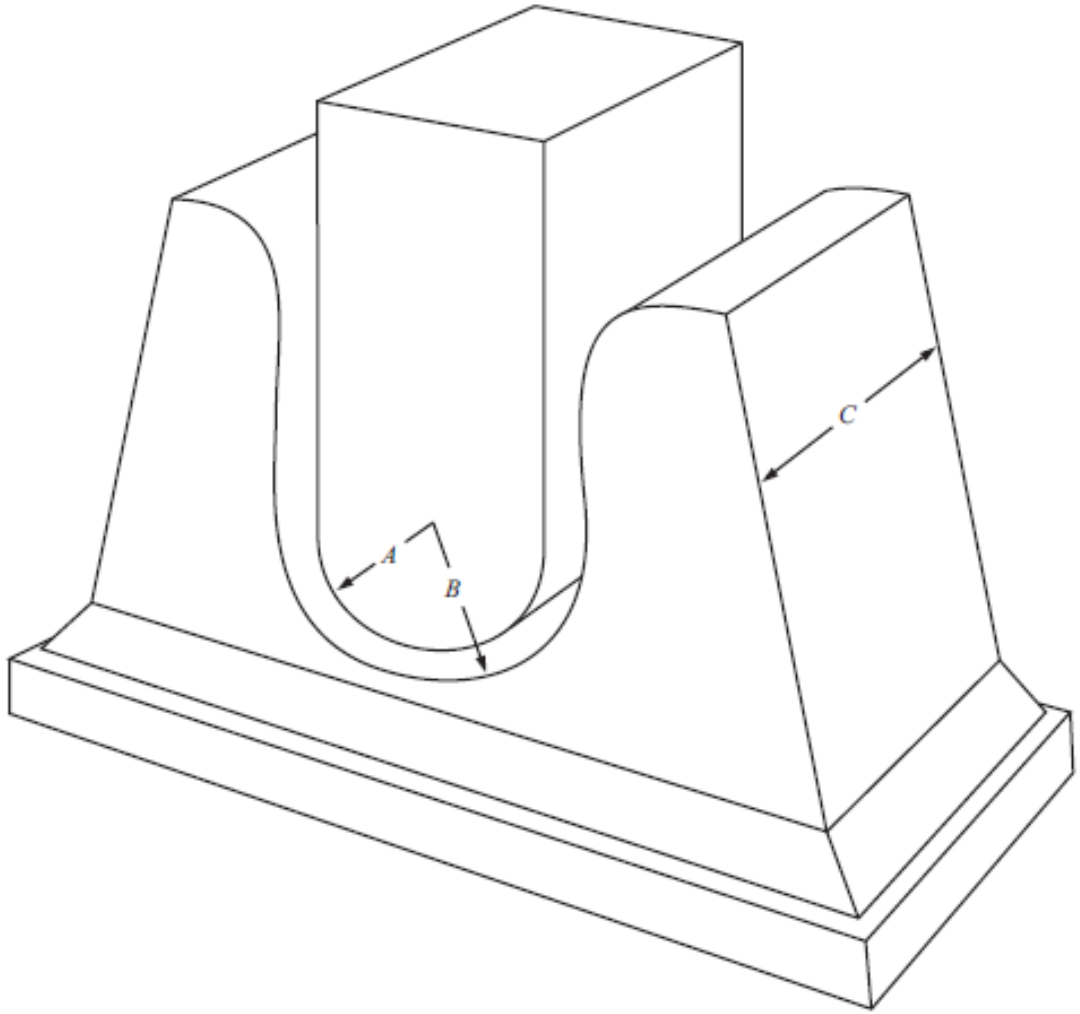
NOTE Dimensions are approximate.

b) Reduced Section Tensile Strength Test Specimen

What Has Changed? Section 5.6

5.6: Testing of Welded Joints—Butt Welds	
5.6.3.3	“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.”
5.6.4.1	Root and Face Bend Test. Preparation. Regarding the root and face bend test specimen prep, new language added: **"The specimen shall not be flattened prior to testing."**
5.6.4.2	Regarding test method for root and face bend, new language added: **"Alternate bend 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."**
5.6.4.3	Requirements. "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."
5.6.5.2	Side Bend Test Method. **"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	Side Bend. Failures. "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."

What Has Changed? Section 5.6



NOTE This figure is not drawn to scale. Radius of plunger, A = 1 ¾ in. (45 mm); radius of die, B = 2 $^{5}/_{16}$ in. (60 mm); width of die, C = 2 in. (50 mm).

Figure 8—Jig for Guided-bend Tests

What Has Changed? Section 5.8

5.8: Testing of Welded Joints—Fillet Welds	
5.8.1	Fillet Welds. Regarding specimens for fillet welds in pipes less than 2.375" O.D., there is new language: "**specimens shall be cut from the same general location**." And if applicable **"two specimens shall be removed from each of two test welds."**

What Has Changed? Section 6

Section 6

Qualification of Welders

Reminder!

These changes only apply to new welders and those up for requalification

What Has Changed? Section 6

6: Qualification of Welders	
6.2.2 [c]	Single Qualification. Essential Variables. Filler Metal. The following constitutes a change in an essential variable and the need for welder requalification: a change in filler-metal classification from Group 1 or 2 to **"any other group or from any Group 3 thru 9 to Group 1 or 2. A change of filler metal classification not listed in Table 1 to any other filler metal classification or vice versa."**
6.2.2 [f]	Position. **"A welder who qualifies in the fixed position shall also be qualified to perform rolled welds within the essential variables qualified. A welder who qualifies on a butt weld shall also be qualified to make lap fillet welds within the essential variables qualified."**
6.3.2 [c]	Multiple Qualification. Essential Variables. Filler Metal. The following constitutes a change in an essential variable and the need for welder requalification: a change in filler-metal classification from Group 1 or 2 to **"any other group or from any Group 3 thru 9 to Group 1 or 2. A change of filler metal classification not listed in Table 1 to any other filler metal classification or vice versa."**
6.6.1	NDT of Butt Welds: General. At the company's option, the qualification butt weld may be examined by radiography **or automatic ultrasonic testing using a qualified NDT procedure** in lieu of the tests specified in 6.5.

What Has Changed? 6.2.2.c and 6.3.2.c

20th Edition

c. A change of filler-metal classification from Group 1 or 2 to Group 3, or from Group 3 to Group 1 or 2 (see Table 1).

21st Edition

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.

Cellulosic

Non-Cellulosic

Table 1—Filler Metal Groups

Group	AWS Specification	Electrode	Flux[c]
1	A5.1	E6010, E6011	
	A5.5	E7010, E7011	
2	A5.5	E8010, E8011	
		E9010	
3	A5.1 or A5.5	E7015, E7016, E7018	
	A5.5	E8015, E8016, E8018	
		E9018	
4[a]	A5.17	EL8	P6XZ
		EL8K	F6X0
		EL12	F6X2
		EM5K	F7XZ
		EM12K	F7X0
		EM13K	F7X2
		EM15K	
5[b]	A5.18	ER70S-2	
	A5.18	ER70S-6	
	A5.28	ER80S-D2	
	A5.28	ER90S-G	
6	A5.2	RG60, RG65	
7	A5.20	E61T-GS[d]	
		E71T-GS[d]	
8	A5.29	E71T8-K6	
9	A5.29	E91T8-G	

What Has Changed? Section 9

Section 9

Acceptance Standards for NDT

No significant changes

What Has Changed? Section 12

Section 12

Mechanized Welding with Filler Metal Additions

Changes here are the same as what was in Section 5 but for mechanized welding.

What Has Changed? Annex A

Appendix → Annex A

Alternative Acceptance Standards for Girth Welds

A.3: Welding Procedure	
A.3.2	Essential variables: New language modifies essential variables to better quantify the variability of welding electrodes and pipe materials.
A.3.4	If a tensile specimen breaks outside of the weld at >95% SMTS, the rule similar to 5.6.2.3 can be used.

Use of Appendix A is not common

What Has Changed? Annex B

Annex B

In-service Welding

Annex B	
B.2.4.3	New section for “Weld Deposition Repairs”
B.4.4	States “In-service welds should be deposited in the circumferential direction”

There is no usage of the legally obligating “shall” used in Annex B. It is only a suggestion, “should.”

What Has Changed? Section 10

Side Note

Section 10

Repair and Removal of Weld Defects

The changes and additions to this section of 1104 were extensive but this section has never been incorporated into Part 192

Impact on New WUA Welding Procedures

The qualification of each welding procedure shall meet or exceed the incorporated by reference edition of API Standard 1104 and 192.225.

Utilize the help from the 21st edition:

- "Final chance" for mechanical tests in Section 5.6
- "Fixed qualifies for rolled" for welder quals in Section 6.2

Ensure new stipulations are followed in new qualifications:

- New SMYS ranges per API 5L
- No flattening bend test specimens
- Be careful of changes greater than 20% in shielding gas flow rates

Questions?