Welding

Part §192

Not applicable to welding during manufacture of pipe and components
§192.225
Welding Procedures

- Welding Performed by “Qualified” Welder
- Welding Procedures “Qualified” Using API 1104 Section 5 or ASME B&PV Section IX
- Recorded in Detail and “Qualified” by Destructive Testing
- Followed when the Procedure is Used
"Qualified Procedure" vs "Qualified Welder"

"qualified procedure test" verifies integrity/metallurgy of that weld

"qualified welder test" verifies ability of that welder
Procedure must be qualified by Destructive Testing
Number, Type, and Locations of Test Straps Required for Procedure Qualification Tests

Notes:
1. At the company’s option, the locations may be rotated, provided they are equally spaced around the pipe; however, specimens shall not include the longitudinal weld.
2. One full-section tensile specimen may be used for pipe with an outside diameter less than or equal to 1.315 in. (33.4 mm).
PROCEDURE SPECIFICATION NO.____________

For _______________________________ Welding of _______________________________ Pipe and Fittings

Process
Material
Diameter _______________________________ Wall thickness _______________________________
Joint design
Filler metal _______________________________ Number of beads _______________________________
Electrical or flame characteristics
Position
Direction of welding
No. of welders
Time lapse between passes
Type and removal of lineup clamp
Cleaning and/or grinding
Preheat stress relief
Shielding gas and flow rate
Shielding flux
Speed of travel
Sketches and tabulations attached ______________________________________________________

Date tested ___________________________ Welder ________________________________
Date approved ___________________________ Welding supervisor __________________________
Date adopted ___________________________ Chief engineer _____________________________
Change in Process or Method of Application

Pipe Grades
- ≤ 42,000 SMYS
- > 42,000 but < 65,000
- ≥ 65,000 - Separate Test for Each Grade
Essential Variables

API 1104 Procedure Qualification

- Joint Design (U or V groove)
- Position (fixed or rolled, horizontal or tilted)
- Wall Thickness Group
  - < 3/16” (.188)
  - 3/16” - 3/4” (.188 - .750)
  - > 3/4” (.750)
Essential Variables
API 1104 Procedure Qualification

- Time Between Passes
  - Max time between root and second

- Direction of welding
  - Uphill or downhill
Essential Variables
API 1104 Procedure Qualification

- Shielding Gas and Flow Rate
- Shielding Flux
- Speed of Travel
- Filler Metal

Group

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<tr>
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<th>AWS Specification</th>
<th>Electrode</th>
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<td>E6010 E6011 E7010 E7011</td>
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<td>A5.5</td>
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<td>A5.1 or A5.5 A5.5</td>
<td>E7015 E7016 E7018 E8015 E8016 E8018</td>
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§192.227
Qualification of Welders

- Section 6 of API Standard 1104
- Section IX of ASME Boiler and Pressure Vessel Code
§192.227 Qualification of Welders

(§192 ONLY)

- Less than 20% SMYS - Appendix C
§192.227
Qualification of Welders

➢ Welder Qualified under Earlier Edition of API 1104 or ASME Section IX---

➢ May Continue to Weld

➢ May Not Re-qualify under that Edition
Qualified Welders

- Must have funny looking hats
- Must have helpers
- Must have BBQ grills & Ice chests
Qualified Welders

Not Quite
API 1104 Welder Single Qualification (Butt or Fillet)

- If Qualified on Butt Welds in Fixed Position @ 45° Angle, Qualified for Butt Welds and Lap Fillet Welds in all Positions.
Essential Variables - Welder Single Qualification

Change in any one of:

- Process
- Direction of Welding
- Filler-metal Classification
- Outside Diameter Group
  - < 2.375”
  - 2.375 – 12.750”
  - > 12.750 “
- Wall Thickness Group
- Position
- Joint Design
API 1104 Welder Multiple Qualification

- Must Make Butt Weld First
- Layout, Cut & Fit Branch Connection
- Cut Hole in Run for Branch
- Make Fillet Weld on Branch/Run Joint
API 1104 - Welder Multiple Qualification

- Butt & Branch Welds Must Be Made on Pipe at Least 6.625”
- 12.75” Qualifies for all Pipe Diameters
- Butt Weld Made in Fixed Horizontal or 45° Angle Position
API 1104 Welder Multiple Qualification

- Cut Full-Size Hole in Run Pipe
- Run Pipe Shall Be Horizontal
- Branch Shall Extend Vertically Downward From Run Pipe
Essential Variables Welder
Multiple Qualification

- Change in welding processes
- Change in direction of welding
- Change in filler metal classifications
§192.229 Limitations on Welders

- Welder whose qualification is based on nondestructive testing may not weld on compressor station pipe and components.
- Must have welded with particular process within the preceding 6 calendar months.
192.229 Additional Limitations

- Welder qualified under Section 6 of API 1104 or Section IX of ASME

To weld on pipe operating at 20% SMYS or more, must have weld tested:
- Every 6 months per API 1104 Section 6 or 9, or
- Twice each CY at intervals Not exceeding 7-1/2 months
§192.229 Additional Limitations

- Welder qualified under Section 6 of API 1104 or Section IX of ASME

To weld on pipe operating at less than 20% SMYS, must:

- Have weld tested every 6 months per API 1104 Section 6 or 9, or
- Re-qualify under Appendix C every calendar year not to exceed 15 months, or
- Cut out and test a production weld twice each calendar year
§192.229 Additional Limitations

- Welder qualified under Appendix C
  - Must re-qualify under Appendix C every calendar year not to exceed 15 months, or
  - Must cut out and test a production weld twice each calendar year (interval cannot exceed 7 1/2 months), or
  - For service lines 2 inches and smaller only, 2 welds tested per App. C, Sec. III
Where Are the Welding Procedures?

- Procedures do not have to be with the welder and chances are the welder will not have them.
- Inspectors are encouraged to have a copy of the procedure and verify that the welder is following the procedure.
Can Operators Share?

- Procedures
  - Yes, if the operator has the procedures and procedure qualification test records.

- Qualified welders
  - Yes in API 1104 20th edition
  - Section 6.1 General - “The qualification of welders shall be conducted in the presence of a representative acceptable to the company.”
Protection from Weather

- The welding operation must be protected from weather conditions that would impair the quality of the completed weld.
§192.233 Miter Joints

- 30% or more SMYS, Maximum of 3°
- >10% SMYS <30%, Maximum of $12^{1/2}$°
  Must be one diameter from any other miter
- 10% or less SMYS, Maximum of 90°
Before beginning any welding, the welding surfaces must be clean and free of any material that may be detrimental to the weld, and must be aligned to provide the most favorable condition for depositing the root bead. This alignment must be preserved while root is deposited.
§192.241 Inspection and Test of Welds

Visual inspection (by individual qualified by training & experience) of the WELDING must be done to insure –

- Welding is done according to procedure, and
- Weld is acceptable per API 1104 Section 9.
§192.241 Inspection and Test of Welds

Welds on pipelines operating $\geq 20\%$ SMYS must be Non-destructively tested, except:

- Welds visually inspected and approved by a welding inspector qualified by training & experience if:
  - Pipe is $\leq 6''$ nom. dia.; or
  - Line operates below 40% SMYS and welds are limited in number.
Part 192

Alternative Acceptance Criteria

API 1104 – Appendix “A” (20th Edition Errata/Addendum July 2007)

- Appendix “A” Is Incorporated by Reference in Part 192.241 (c) as an alternative acceptance criteria if API 1104 Section 9 requirements cannot be met for any reason other than a crack.

API 1104 – Appendix “A” (20th Edition Errata/Addendum July 2007)

- Uses “Fracture Mechanics Analysis” and “Fitness-for-Purpose Criteria” to Determine Weld Alternate Acceptance Criteria.
- Additional Qualification Tests, Stress Analysis, and Inspection are required to use the “Fitness-for-Purpose” criteria.
- Restricted use, not applicable in all conditions.
§192.241
Inspection and Test of Welds
§192.241
Inspection and Test of Welds
§192.243 Nondestructive Testing

- NDT must be performed by any process, other than trepanning, which will clearly indicate defects that may affect the integrity of the weld.
§192.243 What is Trepanning?
Nondestructive Testing

NDT must be performed:

- In accordance with written procedures;
  and

- By persons trained and qualified in the procedures and with the equipment being utilized
§192.243
Nondestructive Testing

- Procedures must be established for interpretation of each test to ensure acceptability of the weld per API 1104 Section 9.
§192.243 Nondestructive Testing

- When required, random testing of each day's welds must be tested at the following rates:
  - Class 1 areas - 10%
  - Class 2 areas - 15%
  - Class 3 & 4, offshore, rights-of-way - 100%, unless impracticable, then 90%
  - Tie-Ins (including replacement sections) - 100%
§192.243 Nondestructive Testing

- Must test some of each welders work each day
- Must retain for life:
  - Record by milepost, engineering station, etc.;
  - Number of welds
  - Number tested
  - Number rejected
  - Disposition of rejects
§192.245

Repair or Removal of Defects

- Each unacceptable weld under §192.241(c);
  - Must be removed or repaired.
  - Removed if crack is $> 8\%$ of weld length

- For repairs, must remove defect down to sound metal, pre-heat if necessary, and re-inspect
Repair of a crack or defect in a previously repaired area must be done in accordance with written repair procedures that have been qualified under §192.225.
§192.309 Repair of Steel Pipe

- (c) Each arc burn on steel pipe to be operated ≥ 40% SMYS must be repaired or removed. If repaired by grinding, must check remaining wall thickness.

- If not repairable by grinding, a cylinder of the pipe containing the arc burn must be removed.
Part 192 Appendix “C”
Basic Test

- Test on pipe 12” or smaller
- Weld in horizontal, fixed position
- Weld according to a qualified, written procedure
Part 192 Appendix “C”
Basic Test

- Cut weld into four coupons
- Subject to a root bend test
- If two or more have a crack >1/8”, weld is unacceptable
- Successful test qualifies welder to weld on pipe diameters ≤ 12 inches
Part 192 Appendix “C”
Service Connections To Mains

- Weld service connection to pipe of typical main size in same position as in field
- Test destructively
Two samples 8” long are cut w/ weld in center

Subject one to guided bend test

Subject second to tensile test

If tensile machine not available, bend test
What About Maintenance/Hot Welding?

- Covered in **API 1104** (20th ed.) Appendix “B” (prev. API RP 1107)

- Appendix “B” *NOT* incorporated by reference in Part 192

- Maintenance Welding includes OQ Covered Tasks

- Operators must qualify Welders for Maintenance Tasks
What should State/Federal inspectors or operators check for compliance regarding Subparts “E” or “D”?

- Written welding procedures with qualifying test results available
- How welders are qualified (API, ASME, Part 192 Appendix C)
- Verification of use of qualified welders
- How welders maintain qualification and re-qualify
- Qualifications of welding inspectors
What should State/Federal inspectors or operators check for compliance regarding Subparts “E” or “D”?

- Adherence to welding procedures/code requirements/housekeeping during field welding
- Use of N.D.T./N.D.T. procedures/qualifications of N.D.T. technicians
- Special procedures for “hot” or repair welding
- Repair criteria for defective welds
- Maintenance of required records
Information Websites

PHMSA Training and Qualification
http://www.phmsa.dot.gov/pipeline/TQ

PHMSA Pipeline Safety Regulations
http://www.phmsa.dot.gov/pipeline/TQ/Regulations