

# **Welding of Pipeline and Related Facilities, and Nondestructive Examination Requirements**

## **STD.8008**

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### **Scope**

- (1) This standard prescribes minimum requirements, procedures, and acceptance standards to be applied for welding steel materials and inspection of welds by nondestructive examination in Enterprise (Company) pipelines, compressor stations, meter stations, pump stations, and fabricated assemblies. This also includes air, oil, and water lines in the compressor stations and pump stations.
- (2) This standard does not apply to welding and/or nondestructive examination that occurs during the manufacturing of steel pipe or steel pipeline components, nor does this standard cover welding associated with in-service welding.
- (3) This standard provides requirements for preheating and stress relieving, and summarizes conditions under which preheating and stress relieving are required. Code minimum requirements for both preheating and stress relieving must still be followed, and any discrepancies between the code and this standard shall be brought to the attention of the Company Project Manager.
- (4) This standard covers welding of unequal thicknesses or strengths, flanges, openings, and elbows.

- (5) Any deviation from this standard must be formally explained, documented and provided for review and approval using the electronic Standards Waiver Request Application provided on the Engineering Standards portal site, unless otherwise noted within this standard.

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## 1.0 REFERENCES

### 1.1. Pipeline and Hazardous Materials Safety Administration (PHMSA)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline
49 CFR 195	Transportation of Hazardous Liquids by Pipeline

### 1.2. American Petroleum Institute (API)

API 1104	Welding of Pipelines and Related Facilities, 20th Edition, October 2005, errata/addendum (July 2007), and errata 2 December 2008
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### 1.3. American Society of Mechanical Engineers (ASME)

ASME B31.3-2018	Process Piping
ASME B31.4-2019	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
ASME B31.8-2018	Gas Transmission and Distribution Piping Systems
2019 ASME Boiler and Pressure Vessel Code	Section V - Non-Destructive Examination Section VIII Div. 1 - Rules for Construction of Pressure Vessels Section IX - Welding and Brazing Qualifications

### 1.4. American Welding Society (AWS)

AWS A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.5	Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	Structural Welding Code – Steel
AWS D10.10	Recommended Practices for Local Heating of Welds in Piping and Tubing

### 1.5. American Society of Nondestructive Testing (ASNT)

SNT-TC-1A	Recommended Practice for Personnel Qualification
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### 1.6. Company Standards

STD.0250	Project Records Management
STD.4600	Pipeline Design for Onshore Pipelines
STD.8004	In-service Welding Preassessment, Evaluation, and Approval
STD.8005	Maintenance/In-Service Welding, Hot Taps, Inspection, and Repair
STD.8006	Welder Qualification

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STD.8007	Welding Procedure and Qualification Documentation Review Process for Code Compliance
STD.8015	Welding Filler Metal/Consumables
STD.8503	General Expectations for Third-Party Inspectors

## 2.0 TERMS AND DEFINITIONS

**AC** – Alternating current

**Back Bevel** – The transition between items having unequal thickness is made by beveling the end of the thicker pipe to match the thickness of the thinner pipe either by machining or grinding.

**Bending Moment** – A force is applied to the pipe causing the pipe to bend. Moments are measured as a force multiplied by distance, (i.e., generated by overbends, sidebends, or sagbends in hilly terrain and high stress concentration locations [e.g., crossings, streams, and sloping hillsides] with stable or unstable soils).

**Company** – Enterprise (if used in connection with a contract or other agreement, the actual Enterprise entity will be the specific Enterprise entity referenced in the contract).

**Company Authorized Representative** – Company authorized welding inspector (e.g. general welding or in-service). Company authorized welding inspectors are provided by the Company Construction & Inspection Services Department only. “See STD.8503” for general expectations for third-party inspectors.

**Company Project Manager** - An employee of Enterprise who has the overall responsibility for the project or a defined scope of work. For example, this can be someone in Capital Projects, Field Engineering, Asset Integrity, Maintenance or Operations.

**Contractor** - Entity or organization contracted to provide services for the Company, who is responsible for ensuring all requirements of this standard and other applicable standards are met.

**Counterbore and taper** – The transition between items having unequal thickness is made by the thicker wall pipe being machined to a wall thickness equal to the thinner wall pipe and then tapered to its original thickness.

**DC** – Direct current

**FCAW** – Flux-cored arc welding

**Gap-A-let®** – A split ring that is engineered and designed to give a pre-measured minimum gap for socket welds.

**Final tie-in weld** – The last pipe-to-pipe weld joint for completion of a pipeline or pipe assembly.

**GMAW** – Gas metal arc welding

**GTAW** – Gas tungsten arc welding

**MT** – Magnetic particle testing

**NBIC** – National Board Inspection Code

**NDE** – Nondestructive examination

**OD** – Outside diameter

**PAL** – Pre-assessment letter

**Prevailing Construction Code** – The code/standard to which the work is being designed, constructed, inspected and tested in accordance with (as applicable), which may include but is not limited to AWS D1.1, AWS D1.6, ASME B31.3, ASME B31.4, ASME B31.8, etc.

**PQR** – Procedure qualification record

**RT** – Radiographic testing

**SAW** – Submerged arc welding

**SMAW** – Shielded metal arc welding

**SMYS** – Specified minimum yield strength

**Sub-Contractor** – Individual or business that has executed a contract with the Contractor to perform a portion of Contractor's obligations under its contract with Company.

**Taper** – See "Back Bevel"

**Transition joint** – A weld joint made between two pieces of pipe having a wall thickness difference greater than 3/32 in. (2.4 mm)

**VT** – Visual testing

**WPS** – Welding procedure specification

## **3.0 WELDING REQUIREMENTS**

### **3.1. General**

- (1) All welding, including temporary welds, utility piping welds, pre-fabricated assemblies, welder qualification welds, welder continuity/renewal welds, and structural welds shall be performed using approved and qualified welding procedure specifications in accordance with this standard.
- (2) All welding, including temporary welds, utility piping welds, welder continuity/renewal welds, and structural welds shall be performed by welders who are qualified for the welding procedure specification to be utilized.
- (3) A Company Authorized Representative shall witness all welding of all process, gas transmission, hazardous liquid, or other types of pressurized piping including temporary welds, unless a previous waiver to witnessing has been granted by the Company using the electronic Standards Waiver Request Application provided on the Engineering portal site.
- (4) The Contractor is responsible for ensuring that no welder shall perform welding unless the welder has been qualified in accordance with Company STD.8006 and that the qualifications have been verified by the Company Authorized Representative.
- (5) A list of qualified welders and the procedures in which they are qualified should be maintained and retained for the life of the project.
- (6) A welder may be required to re-qualify if there is a question about their competence.
- (7) Each welder shall identify his or her work.
- (8) Back welding of pipe, valve, flange, and fitting welds is allowed when approved in the prevailing welding procedure specification.

### **3.2. Welding Restrictions**

- (1) Welding to in-service or pressurized lines shall be prohibited unless a work-specific Pre-Assessment Letter (PAL) has been approved in advance and a Company Authorized Representative (i.e. In-Service Welding Inspector) is monitoring the welding activities. See Company STD.8004 for PAL requirements and Company STD.8005 for in-service welding requirements.
- (2) Chill or backup rings shall not be used.

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- (3) Design of weld fittings shall comply with the appropriate Company Standards (STD.4600 9.3 (4) & (5)).
  - (a) Welding of all socket welds shall be with a low hydrogen process.
  - (b) Single pass welding of socket welds is prohibited.
  - (c) There shall be at least a  $\frac{1}{16}$ -inch (1.6 mm) gap between the end of the pipe and the bottom of the socket.
  - (d) It is preferred that a Gap-A-Let® or similar weld contraction ring is utilized to obtain proper spacing.
  - (e) If a weld contraction ring is not utilized, manual scribing of lines verified by the Company Authorized Representative shall be used as the alternative.
  - (f) Refer to Section 7.2.2 for gap spacing installation witnessing and verification.
- (4) Mitering of joints or fittings (e.g. induction bends, segmentable, etc.) shall not be used.
  - (a) Deflections 3 degrees or less will not be considered a mitering of joints or segmentable fittings and may only be performed on joints or segmentable fittings.
- (5) Seal welding of threaded joints shall not be allowed without prior written approval from the responsible Company Project Manager and Company Welding Department.
- (6) When automatic or semiautomatic welding is used, clusters of surface porosity, bead starts, high points, and heavy silica deposits shall be removed by grinding prior to depositing weld material over them.
- (7) Roll welding will be permitted, provided alignment is maintained by use of skids or structural framework having an adequate number of roller dollies to prevent sag in the supported lengths of pipe.
  - (a) The pipe shall be rolled to maintain welding at or near the top of the pipe.
- (8) Striking of arcs shall be confined within the welding groove.
  - (a) Arc strikes/burns outside of the welding groove must be cut out and replaced as a cylinder unless repair of arc strikes/burns is approved by the Company in very limited case-by-case scenarios.
  - (b) Procedures for repairing arc strikes/arc burns shall be written and approved by the Company Welding Department.
- (9) Welding shall not be done when the quality of the completed weld would be impaired by the prevailing weather conditions, including but not limited to airborne moisture, blowing sands, or high winds.
  - (a) Weather protection devices such as windshields shall be used when necessary.
- (10) Scale and slag shall be removed from each bead and groove. Cleaning may be done with either hand and/or power tools.
- (11) The number of beads shall be such that the completed weld shall have a substantially uniform cross section around the entire circumference of the pipe.
  - (a) At no point shall the crown surface be below the outside surface of the pipe, nor should it be raised above the parent metal by more than  $\frac{1}{8}$  inch (3.2 mm).
  - (b) If the cap height is greater than  $\frac{1}{8}$  inch the cap shall be sanded down to within the maximum height limits above.
  - (c) If such a height will be detrimental to coating applications, additionally the weld toe shall be smooth so that the angle between the weld and the base material (re-entry angle) is not acute.



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- (12) After the root pass has been completed, the second pass (i.e. hot pass) must be started before the maximum time allowed by the welding procedure specification.
- (13) Two passes shall not be started at the same location (i.e. starts and stops between passes shall be staggered).
  - (a) The face of the completed weld should be approximately  $\frac{1}{8}$  inch (3 mm) greater than the width of the original groove.
  - (b) The completed weld shall be thoroughly brushed and cleaned for inspection and coating operations.
- (14) For field applications, girth welds shall have an odd number of passes showing on the cap so that the edges of the passes will not overlap the root pass on a radiograph, unless otherwise approved by the Company Welding Department.
  - (a) When welding on piping having a thickness greater than  $\frac{1}{2}$  inch (12.7 mm), three or five beads shall be showing on the finish pass, with the final bead placement to comply with the welding procedure specification.
  - (b) Welds on material greater than  $\frac{3}{4}$  inch (19 mm) thick may use more than five beads on the finish pass.
- (15) For shop fabrication or manufactured components girth welds should have an odd number of passes showing on the cap so that the edges of the passes will not overlap the root pass on a radiograph.
  - (a) When not practical based on welding techniques / welding processes even number of passes showing on the cap are permitted as long as the final cap pass sequence does not impede with reviewing and interpreting of the radiograph results.
- (16) Two welders are required on pipe diameters over  $12\frac{3}{4}$  inches unless approved by Company Welding Department for field applications.
- (17) For shop fabrication, two welders shall be required for welding 16 inch and larger pipe until completion of the hot pass as a minimum, unless otherwise restricted in the welding procedure specification and/or by the Company Authorized Representative.
- (18) Rolled out welds that are fully supported by the rollers to minimize any bending moments or angular deflection shall have no restriction on the minimum number of welders required.
- (19) No welding shall be done on pressure piping while the pipe is filled with water (such as that used for hydrostatic testing).
- (20) Die stamping shall not be used.
- (21) No oil-based markers shall be used for identifying field welds.

### **3.3. Welding Procedures**

- (1) Approved welding procedure specifications (WPS) shall be detailed written procedure specifications that have been qualified to demonstrate that welds having suitable mechanical properties and soundness can be made by the procedure.
  - (a) The quality of the procedure qualification test welds shall be determined by destructive testing.
  - (b) Each WPS must be recorded in detail during the qualifying tests, and the record shall show complete results of the procedure qualification testing. This record must be retained and followed whenever the procedure is utilized.
  - (c) The Company Welding Department is the authority for providing approval on any WPS.

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- (2) Company approved procedures qualified in accordance with API Standard 1104 shall be the preferred standard for qualification of field WPS(s).
- (a) ASME BPVC Section IX can be used where applicable when authorized by the Company Welding Department.
- (b) Other codes and standards may be used when authorized by the Company Welding Department.
- (3) When selecting a WPS to weld material with different yield strengths, the procedure for the higher yield strength material shall be selected.

### **3.4. Welding Processes**

- (1) Acceptable welding processes with the manual, semi-automatic, automatic and/or a combination of such techniques are as follows;
- Shielded metal arc welding (SMAW)
  - Gas tungsten arc welding (GTAW) and pulsed GTAW (GTAW-P)
  - Gas metal arc welding (GMAW) with solid wire and metal cored electrodes for the following transfer modes:
    - Spray (GMAW-Sp),
    - Short Circuiting (GMAW-S),
    - Pulsed (GMAW-P),
    - Globular (GMAW-G), and
    - Other transfer modes approved by the Company Welding Department
  - Submerged arc welding (SAW)
  - Flux-cored arc welding (FCAW)
  - Other welding processes approved by the Company Welding Department.

### **3.5. Limitations of Fusion Welding Processes**

- (1) The fusion welding processes listed above are acceptable with the restrictions and notes as follows:
- (a) SMAW
- (i) For sour service as per NACE MR0175 / MR0103 or corrosive environments the use of cellulosic consumables shall be limited to the root pass only of a weld.
- (1) It is preferred that the use of an E7010-A1 is utilized for sour service or corrosive environments when the root pass is to be completed with a cellulosic consumable.
- (ii) The use of cellulosic consumables in the PWHT condition is prohibited, with the exception that PWHT welds with root pass welding only completed with cellulosic consumables may be utilized in the PWHT condition, unless otherwise approved by the Company Welding Department.
- (b) GTAW-P
- (i) When used for root pass welding of single-sided joints, GTAW-P shall be performed with the same make and model of equipment using the same program settings as those used in the procedure qualifications.
- Note:** The need to specify the make and model, program, equipment settings, and pulse waveform is based upon the effects these variables have on welding arc

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performance, especially sidewall fusion and out-of-position welding. Studies have shown considerable variation in arc characteristics when one make or model of welding system is compared to another. This variation can lead to welding defects, some of which may be very difficult to detect by radiography.

(c) GMAW-S

- (i) The process shall not be used for branch connections, socket welds, or similar types of joint configurations.
- (ii) GMAW-S may be used for the root and second (i.e. hot) pass welding on piping.
- (iii) Root pass welding with GMAW-S for other applications is permitted, provided the root pass is completely removed from the backside.
- (iv) A separate mock-up qualification is required for GMAW-S root or root and second (i.e. hot) pass welds for each pipe thickness group that is greater than 5/8-inch (16 mm) wall thickness at intervals of 1/8 inch (3 mm).
- (v) For vertical welding, the root pass and second (i.e. hot) pass progression for a material of any thickness may be either uphill or downhill.
- (vi) Variations of the GMAW-S shall have the same limitations as outlined above, except that variations of the GMAW-S process shall be limited to root pass welding only.

(d) GMAW-P

- (i) GMAW-P may be used for any material thickness in any position.
- (ii) Welding shall be performed with the same make and model of welding equipment and using the same program settings as those used in the procedure qualification.

**Note:** It is required that whenever the welding system is changed or the settings on existing equipment significantly altered, the fabricator shall verify weld properties. The extent of verification or testing shall be agreed between the Company Welding Department and fabricator.

(e) SAW

- (i) SAW procedures shall be requalified whenever the welding flux is changed from one manufacturer's trade name to another. Equivalence under ASME BPVC Section II, Part C or AWS filler metal specifications shall not be considered adequate for substitution without requalification.

**Note:** It is recognized that fluxes having the same classification can be very different in their composition. However, nominal flux composition is not included in AWS or ASME specifications/codes and flux suppliers do not normally provide this information. Differences among fluxes of the same classification can result in different and unanticipated weld properties when these fluxes are used interchangeably over the range of variables typically stated in weld procedure specifications.

- (ii) Manually held (semiautomatic) SAW is not permitted for welding pressure-containing parts, unless approved by the Company Welding Department.
- (iii) A separate qualification is required for SAW welds in which any pass thickness is greater than 1/2 inch (13 mm).

(f) FCAW

- (i) Self-shielding FCAW (FCAW-S) may be used only for carbon steel structural items unless approved by Company Welding Department.
  - (1) Electrode types identified by the consumable manufacturer for multi-pass applications shall be used.

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- (2) FCAW-S shall not be used with other welding processes without qualifying the specific combination.
- (ii) FCAW with external gas shielding (FCAW-G) may be used for either groove or fillet welds for pressure boundary or structural welding.
- (iii) Welding consumables for either the FCAW-S or FCAW-G process shall be limited to the ASME/AWS classification used in the Procedure Qualification Record (PQR) and shall be the classification type which have specified minimum impact toughness test requirements.
- (iv) For welding pressure-containing equipment wall thickness in excess of 3/16 inch (5 mm), the following restrictions apply:
  - (1) Welding consumables are limited to the manufacturer trade name used in the PQR.
  - (2) The diffusible hydrogen limit for the welding consumables (as manufactured) shall meet the specifications of Table 3-1.

**Table 3-1 Diffusible Hydrogen Limits for FCAW Consumables**

Specified Minimum Tensile Strength for Base Metal	Maximum Diffusible Hydrogen Designation (per ASME/AWS SFA/A5.20 or SFA/A5.29)
≤ 70 ksi (483 MPa)	H16
> 70 ksi (483 MPa) and ≤ 85 ksi (587 MPa)	H8
> 85 ksi (587 MPa)	H4

**3.6. Equipment**

- (1) Welding equipment for arc welding shall be of a size and type suitable for the work and shall be maintained in such condition as to ensure acceptable welds, continuity of operation, and safety of personnel.
  - (a) Arc welding equipment shall be the type that can be operated within the amperage and voltage ranges specified in the qualified welding procedure specification.
  - (b) Any equipment that does not meet the requirements shall be repaired or replaced.
- (2) For SMAW, the electrode holder shall be of the fully insulated type.
  - (a) On cross-country pipelines, un-insulated electrode holders may be used when allowed by the Company.

**3.7. Welding Materials/Consumables**

- (1) Filler metals and fluxes shall be stored and handled as to avoid damage to them and to the containers in which they are shipped.
  - (a) Those in opened containers shall be protected from deterioration, and filler metals that are coated shall be protected from excessive moisture changes.
  - (b) Filler metals and fluxes that show signs of damage or deterioration shall not be used.
- (2) Welding electrodes shall be purchased in hermetically sealed containers. Any contaminated welding electrodes shall be discarded.

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- (3) Low hydrogen electrodes to be used should be stored in either quivers and/or ovens at a temperature between 200°F and 350°F after the electrodes have been removed from their sealed containers.
  - (a) Any low hydrogen electrodes that have been exposed to moisture for longer than four hours and/or which are of a questionable condition shall be discarded.
  - (b) Re-baking of low hydrogen electrodes shall not be permitted.
- (4) Cellulosic electrodes may require storage in warming cabinets if ambient moisture conditions will be detrimental to the weldability of these consumables.
  - (a) At no time shall cellulosic electrodes be stored in quivers and/or ovens and baking of cellulosic electrodes shall not be permitted.
- (5) The shielding atmosphere to be used shall be qualified for the material and the welding process.
- (6) Shielding gases shall be kept in the containers in which they are supplied, and the containers shall be stored away from the extremes of temperature.
  - (a) Gases shall not be field intermixed in their containers.
  - (b) Gases that are of questionable purity and those in containers that show signs of damage shall not be used.
- (7) Company approved welding filler materials/consumables can be found in Company STD.8015.

**3.8. Demagnetization**

- (1) When pipe has a magnetic flux density reading exceeding 20 gauss and/or which adversely affects welding operations, the pipe shall be demagnetized. Approved methods for demagnetization of pipe include the following:
  - (a) Utilizing a manufactured demagnetization/degauss system; or,
  - (b) Wrapping welding leads around the pipe.

**Note:** The Company Welding Department shall be contacted for instructions before utilizing the wrapped welding leads approach. Hammering of the pipe in an attempt to demagnetize it shall not be permitted.
- (2) Approved methods for demagnetization of localized areas such as repair areas are the same as for piping outlined above in section 3.8(1) of this standard.
  - (a) Additionally, the use of a magnetic particle AC or AC/DC yoke is permitted in these localized areas (i.e. repair areas) in an attempt to reduce the residual magnetism.

**3.9. Electrical Grounding of Power Supplies/Welding Circuit**

- (1) The electrical work lead (i.e., ground connection) shall be securely fastened, but not welded, to the work by means of clamps or other mechanical means and shall fit in a manner to prevent the possibility of arc burns.
  - (a) Connections shall avoid notch damage to the pipe.
- (2) For “grasshopper” type ground connections, the metal contact area that contacts the pipe surface shall be made of material similar to the pipe (e.g., magnetic clamps, chisel points, file stock and backhoe teeth are not acceptable).
  - (a) Additionally, copper or copper alloys shall not be used for the contact area.

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- (3) For “grasshopper” type ground connections, the contact area shall be large enough to prevent local overheating or arcing.
  - (a) Only the contact area shall be uninsulated, all other parts of the ground clamp component that must rest on the pipe shall be electrically insulated to prevent the possibility of arc burns.
  - (b) The metal contact area of the ground clamp shall be confined to the groove/weld metal area.
- (4) For ground connections other than “grasshoppers”, the contact area shall be large enough to prevent local overheating or arcing.
  - (a) The use of copper, copper alloys and/or material similar to the pipe is permitted for clamp-on or C-clamp style ground connections.
- (5) The area of contact on the pipe must be free from any scale, rust, oil, grease, oxides, or dirt that may act as points of insulation.
- (6) Welding machine leads shall be fully insulated, and any leads with insulation damage shall either be discarded or safely repaired to meet applicable safety standards.
- (7) If multiple electrical work leads (i.e. ground cables) from several welding machines are attached to a “ground bar,” before proceeding with a single electrical work lead (i.e. ground cable) to the ground clamp, the attachment point (i.e. ground bar) shall be electrically insulated from the structure it is attached to (if applicable) and shall be electrically insulated to avoid secondary shock.
  - (a) The single electrical work lead (i.e. ground cable) that runs to the ground clamp shall be of proper size for the total potential welding current (i.e. current capacity or amperage rating).

**3.10. Pipe Movement – Push/Pull Racks**

- (1) When the utilization of push and/or pull racks are implemented, the pipe shall not be moved until the complete root pass and hot pass have been deposited.
- (2) If NDE (e.g. VT, MT, RT, etc.) determines that there is a crack in the root of the weld, the weld shall be cut out and evaluated by destructive examination to establish if the defect is a crack.
- (3) If a second crack is found in the weld root (as verified by destructive testing), from that time forward, the first fill pass shall be deposited before any pipe movement.
- (4) The Contractor shall absorb all costs associated with the evaluation of potential cracks by destructive testing.

**3.11. Minimum Distance**

- (1) Pipelines should have a minimum distance of five times pipe diameter in length between girth welds for straight run sections of cross-country pipelines, with a minimum distance of ten feet between girth welds.
  - (a) All distances less than this shall be approved by the Company representative in consultation with Company engineering.
- (2) All fabricated assemblies and plant piping may have distances less than three times pipe diameter between girth welds, however a minimum distance of one and one-half pipe diameters is recommended.
  - (a) All distances less than one and one half pipe diameters shall be approved by the Company representative in consultation with Company engineering.

### **3.12. Protection of Hot Welds**

- (1) Every effort shall be made by the contractor to allow all welds to cool slowly to ambient temperatures to the satisfaction of the Company.
- (2) Quenching in any manner (e.g. water, air, etc.) is prohibited unless specifically tested and qualified during the procedure qualification program.
  - (a) Protection of welds from any form of precipitation coming into contact with either an unfinished and/or finished weld(s), shall be wrapped to protect the weld.
- (3) Wrapping of hot welds with insulation and/or blankets shall be completed to protect from sudden cooling or quenching when the following conditions exist:
  - (a) If required by the WPS.
  - (b) The ambient temperature is below 32°F.
  - (c) Possibility of rain, sleet, snow, etc.
  - (d) Excessive windy conditions determined by the Company Authorized Representative that would allow accelerated quenching of the weld.
- (4) Insulation wrapping / blanket material shall be K-Wool (or equivalent).

## **4.0 DESIGN AND PREPARATION OF A JOINT FOR PRODUCTION WELDING**

- (1) The surfaces to be welded shall be smooth, uniform, and free of laminations, tears, scale, slag, grease, paint, and other material that might adversely affect the welding.
  - (a) The joint design and spacing between abutting ends shall be in accordance with the WPS to be used.
- (2) For buried longitudinal seamed pipelines, the longitudinal seams on adjacent pipe shall be staggered, placing one approximately in the 10 o'clock position and the other approximately in the 2 o'clock position.
  - (a) For piping with an outside diameter less than fourteen inches, a minimum distance of three inches between longitudinal seams is required, unless a lesser distance is approved by Company engineering.
  - (b) For piping with an outside diameter greater than or equal to fourteen inches, a minimum distance of six inches between longitudinal seams is required, unless a lesser distance is approved by Company engineering.
- (3) For buried spiral seam welded pipelines, it is required that the seams of adjacent pipe shall be staggered with a minimum distance of 2 inches (50.8 mm) between spiral seams, unless a lesser distance is approved by Company engineering.
- (4) Each piece of pipe or subassembly shall be free of debris and foreign material before being welded into the pipeline.
- (5) The alignment of the abutting ends shall minimize the offset between surfaces.
  - (a) For pipe of the same nominal wall thickness, the offset at the root should not exceed  $\frac{1}{8}$  inch (3.2 mm). Any greater offset caused by dimensional variations shall be equally distributed around the circumference of the pipe.
  - (b) Hammering of the pipe to obtain proper line-up is not allowed.
  - (c) When welding material with different wall thicknesses, see Section 4.1 of this standard.



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- (6) Line-up clamps shall be used in accordance with the requirements of the WPS.
  - (a) When it is permissible the line-up clamp may be removed if the following requirements are met for the welded root bead:
    - (i) Accumulative length of root bead is of no less than 50 percent of the pipe circumference welded, and
    - (ii) Welded in approximately equal length beads, and
    - (iii) Welded beads are in approximately equally spaced sections around the circumference of the joint
  - (b) However, when an internal line-up clamp is used and conditions make it difficult to prevent movement of the pipe, or if the weld will be unduly stressed, the root bead shall be completed before releasing clamp tension.
- (7) Internal line-up clamps shall be used wherever practical.
  - (a) External line-up clamps shall be used where internal line-up clamps are impractical.
  - (b) The Company Welding Department may approve an alternate based on application or WPS.
- (8) Pipe ends should be field beveled by machine tool, machine oxy-fuel cutting, and/or machine plasma arc cutting.
  - (a) Manual oxy-fuel cutting may also be used if so authorized by the Company Authorized Representative.
  - (b) The beveled ends shall be reasonably smooth and uniform, and dimensions shall be in accordance with the qualified welding procedure specification.
  - (c) Oxy-fuel and plasma arc cutting beveled edges shall be dressed to shiny metal following cutting by grinding and/or sanding.
- (9) When applicable, code references to welding joint designs shall be followed (B31.4 434.8.6 and B31.8 Appendix I).

#### **4.1. Welding Unequal Wall Thicknesses and/or Strengths**

- (1) The transition between ends of unequal thickness may be accomplished by back beveling, or counterbore and tapering before welding, as illustrated in Figure 4-1, or by means of a prefabricated transition ring.

**Note:** The lower stress concentration factor of the counterbore and tapered transition at the weld root compared to back-bevel transition makes the counter bore and tapered transition more resistant to fatigue loading and the preferred method to utilize whenever possible.
- (2) If a transition ring is used, the design pressure of the facility must be set to incorporate the smaller wall thickness, the lower design factor (F), and the higher SMYS of the two pipes being joined.
- (3) All transition joints should be placed in a location with minimum bending moment.
- (4) The sketches in Figure 4-1 illustrate acceptable preparations for joining pipe ends by butt welding for materials having unequal wall thicknesses and/or with unequal specified minimum yield strengths.
  - (a) The thickness of the thinner wall material is labeled "t."
  - (b) The maximum thickness of the thicker material which may be used for design purposes is  $t_d$ .
  - (c) The  $t_d$  may not be greater than  $1.5t$ .



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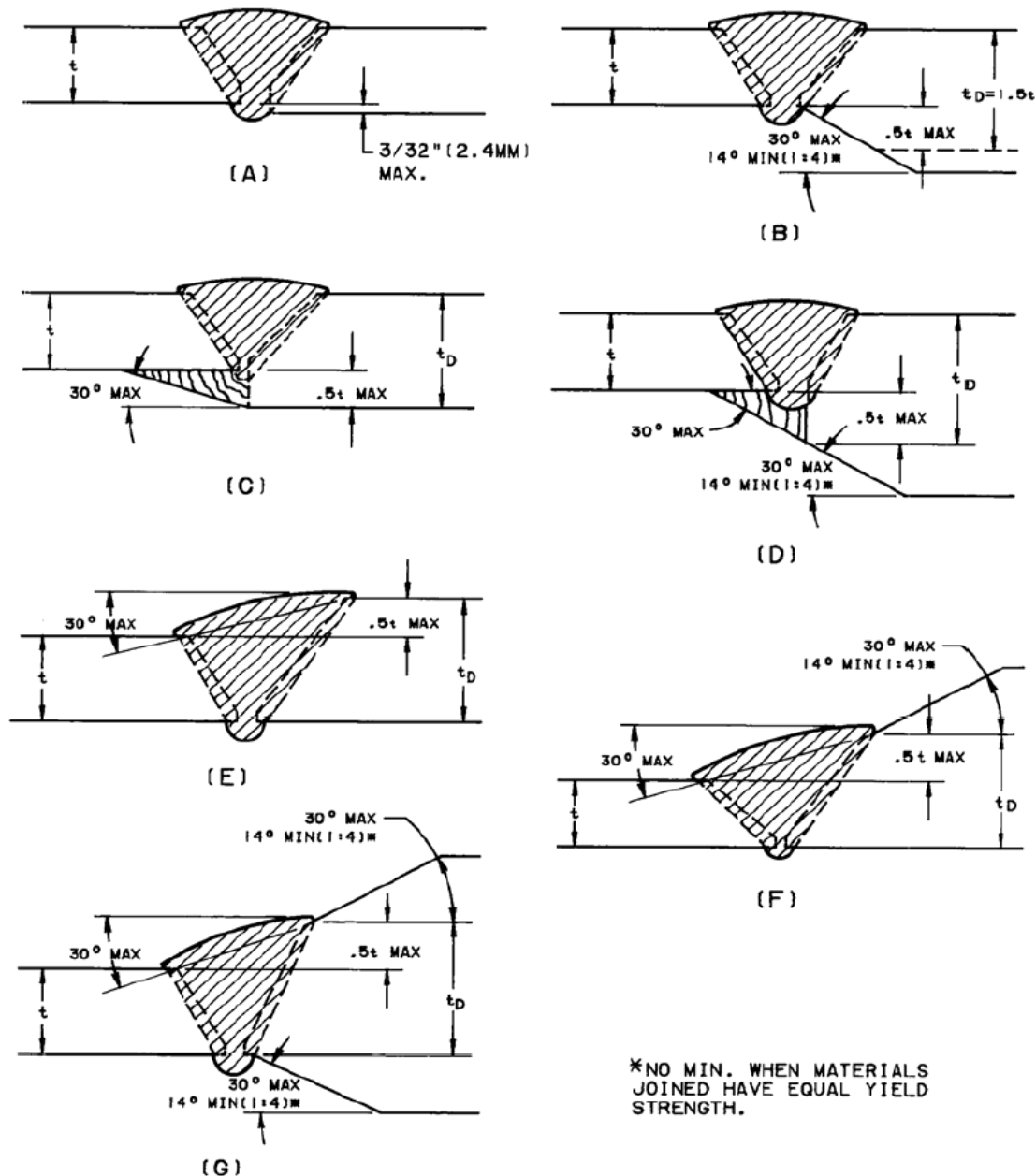
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- (5) Back-bevel transition may be completed by grinding or machining.  
**Note:** It is the preferred method whenever possible to machine back-bevel transitions.
- (6) A 14-degree (4:1) slope rather than the 30-degree slope should be considered for back-bevel transitions.
- (7) The thickness of the sections to be joined, beyond the joint design area, shall comply with the design requirements of this section.
- (8) When the minimum specified yield strengths of the sections to be joined are unequal, the deposited weld metal shall have mechanical properties at least equal to those of the section having the higher strength.
- (9) Sharp notches, grooves, or similar features that are detrimental to weld quality at the edge of the weld joint where it joins a slanted surface shall be avoided.
- (10) For joining unequal thicknesses of equal specified yield strengths, the rules given herein apply, except there is no minimum angle limit to the taper.
- (11) For unequal internal diameters, piping which will operate at hoop stresses of less than 20 percent of specified minimum yield strength.
- (a) If the nominal wall thicknesses of the adjoining ends do not vary more than  $\frac{1}{8}$  inch (3.18 mm), it requires no special treatment provided adequate penetration and bond is accomplished in welding.
- (12) For unequal internal diameters and stress levels above 20 percent of the minimum specified yield strength, the following parameters will apply:
- (a) If the nominal wall thicknesses of the adjoining ends do not vary more than  $\frac{3}{32}$  inch (2.4 mm), no special treatment is necessary provided full penetration and bond is accomplished in welding. See Figure 4-1 (A).
- (b) Where the nominal internal offset is more than  $\frac{3}{32}$  inch (2.4 mm) and there is no access to the inside of the pipe for welding, the transition must be made by a taper cut on the inside end of the thicker section. See Figure 4-1 (B).
- (i) The taper angle shall not be steeper than 30-degrees nor less than 14-degrees.
- (c) Where the nominal internal offset is more than  $\frac{3}{32}$  inch (2.4 mm), but does not exceed one-half the thinner section, and there is access to the inside of the pipe for welding, the transition may be made with a tapered weld as shown in Figure 4-1 (C).
- (i) The land on the thicker section must be equal to the offset plus the land on abutting section.
- (d) Where the nominal internal offset is more than one-half the thinner section and there is access to the inside of the pipe for welding, the transition may be made with a taper cut on the inside end of the thicker section as shown in Figure 4-1 (B), or by a combination taper weld to one-half the thinner section and a taper cut from that point as shown in Figure 4-1 (D).
- (e) For unequal external diameters, where the external offset does not exceed one-half the thinner section, the transition may be made by welding as shown in Figure 4-1 (E), provided the angle of rise of the weld surface does not exceed 30 degrees and both bevel edges are properly fused.
- (f) Where there is an external offset exceeding one-half the thinner section, that portion of the offset over 0.5t shall be tapered as shown in Figure 4-1 (F).

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- (g) For unequal internal and external diameters, as shown in Figure 4-1, where there is both an internal and an external offset, the joint design shall be a combination of Items (A) to (F); that is, item (G). Particular attention must be paid to proper alignment under these conditions.
- (13) Back-bevel transition joints shall not be utilized as a final tie-in weld with the exception of cap assemblies, test heads and/or test cap assemblies.
- (14) The counterbore and taper transition joint or back-bevel transition joint shall not have an angular weld misalignment or miter.

**Figure 4-1: Acceptable Design for Unequal Wall Thickness**



**4.1.1. Inspection of Back-Bevel Transitions**

- (1) This section shall be used for the inspection of back-bevel transitions produced with non-shop fabricated welds using cellulosic consumables (e.g., root and hot pass), intended for buried service for pipe with a grade greater than 52 ksig.
  - (a) Shear wave or Time of Flight Diffraction (TOFD) ultrasonic inspection shall be performed as a secondary inspection to screen for lack of fusion in the root and/or cracking.
  - (b) Shear wave or TOFD ultrasonic inspection should be performed at least 12 hours after weld completion where other delayed hydrogen cracking mitigation has not been implemented.

**4.2. Bends and Elbows****4.2.1. General**

- (1) Factory-made, wrought-steel welding elbows or transverse segments cut from elbows may be used for changes in direction provided that the arc length measured along the crotch is at least 3 inches (76.2 mm) on pipe sizes 2 inch (50.8 mm) or larger.
- (2) Arc length measurements along the crotch less than 3 inches (76.2 mm) are permitted with Company Project Manager approval in writing (e.g. electronic or written).

**4.2.2. Restrictions**

- (1) Elbows for field cutting shall state on the bill of materials "size fittings for field cutting" to ensure true roundness or circularity.

**4.3. Branch Connections and Reinforcement**

- (1) Saddles shall not be tack-welded to the riser while the branch weld is being made. Wire or soft plugs shall be used for this purpose.
- (2) Weep hole plugs in saddles shall be removed and discarded before welding the saddle. The weep hole shall be sealed with a non-pressure containing watertight sealant such as silicone.
- (3) If saddles have to be heated for shaping aprons to conform to the run diameter, the saddles shall be allowed to cool to an atmospheric temperature before welding operations commence.
  - (a) When it is necessary to split saddles to apply them, the cut surface shall be beveled to an angle of 37½ degrees, plus or minus 2½ degrees.
- (4) The hole cut for a branch connection shall not be made in a girth weld. For new construction, the hole shall not be cut in a longitudinal weld.

**5.0 PREHEATING**

- (1) Preheating shall be as specified in the WPS for either Company or Contractor Procedures.
- (2) When non-Company WPS indicate "no preheating required" and/or a "minimum of 50°F" alternative preheating requirements shall comply with Section 5.1 below when any of the following conditions are true:
  - When the pipe is moist due to weather conditions such as rain, snow, or dew the pipe shall be heated to dry the pipe.
  - Welding of pipe, valves, flanges and fittings 14 inch OD and larger.
  - Welding wall thicknesses greater than 0.500 inch (12.7 mm).
  - Welding materials of grades X60/Y60/F60, etc. or higher.
  - Welding carbon steel, if preheating will alleviate existing conditions that would limit the welding technique or tend to adversely affect the quality of the weld.

**Note:** Vessel preheating requirements are shown on the WPS and are given in ASME BPVC Section VIII.

### **5.1. Preheating Temperatures**

- (1) When preheating is required by Section 5.0(2), preheating temperatures shall be a minimum of 200°F and maximum of 350°F, unless otherwise approved by the Company Welding Department.
- (2) When steel materials with different preheat temperatures are being preheated for welding, the higher temperature must be used.

### **5.2. Preheating Methods**

- (1) Preheating temperatures shall be checked by the use of temperature-indicating crayons, pellets, thermocouples, pyrometers, or other methods acceptable to the Company Authorized Representative.
  - (a) Using the warm-to-the-hand method is not acceptable.
- (2) As a minimum and/or when not specified in the WPS, a band extending a minimum of 3 inch (77 mm) on each side of the groove shall be heated to the preheat temperature.
- (3) Preheat temperature shall be measured at the start of welding to ensure it is not less than the required preheat temperature.
- (4) Localized overheating must be prevented.
- (5) Deposits of soot from acetylene torches or other heating devices shall be cleared away from the welding area before welding.

## **6.0 HEAT TREATMENT / STRESS RELIEVING**

### **6.1. Hydrogen Bake-out of Welds or Material**

- (1) When required based on design criteria, service environment, WPS, etc. a hydrogen bake-out of welds or the proposed weld area shall be completed following one of the two cycles described below, unless a more stringent methodology has been indicated in the project documentation.
  - (a) Heat the entire circumference of the weld and/or proposed weld area including six inches in all directions within 500 – 600°F.
    - (i) The heated area shall be immediately wrapped with an insulation material such as K-Wool (or equivalent).
    - (ii) The heated area shall remain wrapped until the area has cooled to ambient temperatures but no sooner than four hours.
  - (b) Heat the entire circumference of the weld and/or proposed weld area including six inches in all directions within 500 – 600°F.
    - (i) Once the 500 – 600°F temperature has been established, the weld and heated area will be allowed to cool but shall not fall below 400°F within the first hour.
    - (ii) During the first hour of cooling, the heated area should remain between 450 – 500°F.
    - (iii) After the first hour has elapsed, further cooling will be allowed but shall not fall below 350°F.
    - (iv) During the second hour, the heated area should remain between 350 – 400°F.
    - (v) Once the second hour has expired, the weld shall be allowed to cool to ambient temperatures with no further heating required.

## **6.2. Post Weld Heat Treatment/Stress Relieving**

### **6.2.1. General**

- (1) Stress relieving is a means for relieving internal stresses, improving weldment microstructure, and restoring properties affected by welding. This is accomplished by uniform heating and cooling to a sufficient temperature below the critical range.
- (2) In general, welds on carbon steel with a wall thickness of more than 1<sup>1</sup>/<sub>4</sub> inch (> 3<sup>3</sup>/<sub>4</sub> inch for B31.3 piping) must be stress relieved.
  - (a) There may be other areas where engineering judgment must be used to determine stress relief requirements such as service conditions.
  - (b) The Company Project Manager is responsible for designating which other welds require stress relief.
- (3) Stress relieving drawings shall be provided by the Company Project Manager for all compressor and pump station projects.
- (4) When a weld connects pipe or components that are of different thicknesses, the wall thickness to be used in determining whether stress relieving is required under this section is as follows:
  - (a) In the case of pipe connections, the thicker of the two pipes joined, as measured at the weld joint; or
  - (b) In the case of branch connections and slip-on flanges, the thickness of the pipe run or header.
- (5) Local stress relieving involving circumferential bands around piping shall be performed according to AWS D10.10.
- (6) Vessels shall be stress relieved as required in ASME BPVC Section VIII and as specified in the WPS.
  - (a) Weld repairs or alterations to previously stress relieved vessels shall be stress relieved in accordance with the NBIC.

### **6.2.2. Temperatures**

- (1) The following are typical ASME stress relieving requirements for carbon steel. The Company Project Manager is responsible for specific stress relief requirements.
- (2) Stress relieving must be performed at a temperature of at least 1,100°F (593°C) for carbon steels.
  - (a) When stress relieving a weld between steel materials with different stress relieving temperature requirements, the higher temperature must be used.
- (3) When heating, temperatures shall be brought up first to 600°F (315°C).
  - (a) From 600°F (315°C) to the required temperature, the rise shall be made slowly at a maximum rate of 500°F (260°C) per hour.
  - (b) The holding time shall be one hour per inch of thickness, but not less than 30 minutes.
- (4) When cooling, the temperature shall be brought down slowly from the holding temperature at a maximum rate of 500°F to 600°F (260°C to 315°C) per hour.
  - (a) From 600°F (315°C) down, the cooling may be done in air as long as it is uniform.
- (5) The following precautions must be taken:
  - Heating and cooling rates must be adjusted for wall thicknesses above one inch. The rates shall be 500°F (260°C) per hour divided by the maximum wall thickness.
  - Water cooling shall not be performed under any circumstance.

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- (6) When stress relieving, the temperature must be monitored to ensure that a uniform temperature is maintained and that the proper stress relieving cycle is accomplished.
  - (a) Temperatures shall be checked by the use of the thermocouple pyrometers or other suitable equipment.
  - (b) On pipe, one thermocouple shall be placed on the bottom and one on top when doing local stress relieving.
  - (c) For furnace stress relieving, several thermocouples shall be placed on the item.
- (7) A chart showing temperature readings from a pyrometer shall be required from each heat so as to document that the item was properly stress relieved.
  - (a) The documentation shall include the type of pipe material.
  - (b) Contractors shall provide stress relieving records and temperature charts to the Company.

**6.2.3. Methods**

- (1) Stress relieving shall be accomplished by the following methods:
  - (a) Heating the complete structure as a unit.
  - (b) Heating a complete section containing the weld or welds to be stress relieved before attachment to other sections of work.
  - (c) Heating a part of the work by heating a circumferential band containing the weld at the center.
    - (i) The width of the band which is heated to the required temperature shall be at least two inches greater than the width of the weld reinforcement.
    - (ii) Care should be used to obtain a uniform temperature around the entire circumference of the pipe.
    - (iii) The temperature shall diminish gradually outward from the ends of this band.
  - (d) Heating a circumferential band around the header pipe with the branch or welded attachment at the middle of the band.
    - (i) The width of the band shall be at least two inches greater than the diameter of the weld that joins the branch or attachment to the header.
    - (ii) The entire band shall be brought up to the required temperature and held for the time specified.

**6.2.4. Equipment**

- (1) Stress relieving shall be accomplished by any of the following means, provided a uniform temperature is maintained during the stress relieving:
  - Electric induction
  - Electric resistance
  - Furnace heating
  - Burner heating

## **7.0 NONDESTRUCTIVE EXAMINATION OF WELDS**

### **7.1. Visual Examination of Welds**

- (1) Visual inspection of welding shall be conducted to ensure:
  - (a) The welding is performed in accordance with a Company approved WPS.

- (b) The welding is performed in accordance with the prevailing construction code.
- (c) The weld meets the requirements of this section and the Company's construction standards.
- (d) Visual examination is supplemented by nondestructive examination.

## **7.2. Nondestructive Inspection and Examination of Production Welds**

- (1) For pipelines and facilities constructed in accordance with 49 CFR Part 192 / ASME B31.8, 49 CFR Part 195 / ASME B31.4, all inspection and examination of production welds shall be in accordance with API Standard 1104.
- (1) For piping constructed within a ASME B31.4, or ASME B31.8 facility that falls under the prevailing construction code of ASME B31.3, inspection and examination for such welds made under that code shall be per ASME B31.3 (See Section 7.6.4(1) below for further detail).

## **7.3. Nondestructive Examination Methods**

- (1) This section specifies the type of inspection methods that shall be used for certain types and sizes of welds.
  - (a) This section does not specify which welds are to be inspected.
  - (b) Inspection frequency is specified in Section 7.6 of this standard.
- (2) Fillet welds, branch connections and welds of such configuration that cannot be radiographed, shall be examined using the liquid magnetic particle method.
  - (a) If the use of the liquid magnetic particle method is not applicable (i.e., stainless steels, non-ferromagnetic materials, restrictive joint configurations, etc.) the liquid penetrant method may be used.
- (3) Girth welds in pipe 2 inch (50.8 mm) or larger in diameter shall be examined by the radiographic or ultrasonic methods.
- (4) Girth welds in pipe less than 2 inch (50.8 mm) in diameter shall be examined by:
  - (a) The liquid magnetic particle method, or
  - (b) If the use of the magnetic particle method is not applicable (i.e., stainless steel, non-ferromagnetic materials, restrictive joint configurations, etc.), the liquid penetrant method may be used, or
  - (c) If required by contractual agreement or determined by the Company Authorized Representative to be pertinent, the radiographic method.

## **7.4. Nondestructive Examination Procedures**

- (1) Nondestructive examination of welds shall be performed by any process, other than trepanning, that will clearly indicate defects that may affect the integrity of the weld.
- (2) Nondestructive examination of welds must be performed as follows:
  - (a) In accordance with written (See 7.4.4) and qualified procedures (See 7.4.5); and
  - (b) By personnel who have been trained and qualified in the established procedures and with the equipment employed in the examination.
- (3) NDE personnel shall be certified as Level II or III in the applicable inspection method in accordance with ASNT Recommended Practice Document No. SNT-TC-1A.
- (4) Nondestructive examination procedures shall be authored and approved by the NDE contractor's Level III personnel, per the requirements of API 1104 and other applicable standards as required.



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- (5) Nondestructive examination procedures shall be demonstrated by the NDE contractor that the proposed procedure will produce acceptable results prior to being used on a production weld and the NDE contractor shall use such procedures for production testing.
  - (a) For radiographic examination methods, the Company Authorized Representative shall accept or reject the proposed radiographic procedure qualification shot per the requirements of paragraph 11.1.1 of API Standard 1104.

## **7.5. Nondestructive Examination Records**

- (1) When nondestructive examination is required under this procedure, each operator shall retain, for the life of the pipeline, a record showing by milepost, engineering station, or geographic feature, the number of girth welds made, the number nondestructively examined, the number rejected, and the disposition of the rejects.
- (2) The NDE records shall be furnished daily to the Company's Authorized Representative providing the minimum information:
  - (a) The number of welds nondestructively examined and accepted.
  - (b) The number of welds rejected.
- (3) Each radiographic examination report shall include a statement that all applicable code requirements have been met, and each report shall be signed by the Level II or III radiographer.
  - (a) Radiographers shall report to the Company all defects as defined by API Standard 1104 observed in the image(s), it is not a requirement for the radiographer to report all imperfections observed.
- (4) Upon project completion, if not sooner, the film and related inspection reports shall be sent to an appropriate location for storage until such time the film can be properly disposed of.
- (5) When applicable, drawings that are marked with radiographic information for compressor stations, fabrications, or other facilities shall be filed with the radiograph report and be handled the same as the report.

## **7.6. Nondestructive Examination Frequency**

### **7.6.1. General**

- (1) This procedure applies to both permanent welds and temporary welds. It does not apply to structural welds that fall under the construction code AWS D1.1 or similar.
- (2) The Company's directive is to have nondestructive examination performed on 100 percent of the welds.
  - (a) When reduced nondestructive examination is 1) permitted and 2) necessary only because testing would be impracticable, the minimum percentages (specified in sections 7.6.2, 7.6.3, and 7.6.4), shall be selected at random by the Company, and must be nondestructively examined over their entire circumference.

### **7.6.2. Pipelines Constructed in Accordance with 49 CFR Part 192 or ASME B31.8**

- (1) For pipelines constructed in accordance with 49 CFR Part 192 or ASME B31.8, all of the nondestructive examination requirements identified in Section 7.6.2 must be completed.
- (2) Each circumferential girth/butt weld of steel pipe that is located where the stress during bending causes a permanent deformation in the pipe shall be nondestructively examined 100 percent after the bending process.

**Note:** This requirement applies to all pipe sizes and stress levels.

- (3) 100 percent shall be nondestructively tested for any of the following locations;



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- (a) All tie-ins, including tie-ins of replacement sections.
  - (b) All old (preexisting) girth/butt welds shall be nondestructively tested when installing used pipe that contains existing girth/butt welds.
  - (c) Pre-tested pipe placed in the line.
- (4) All welds installed each day in the following locations shall be 100 percent nondestructively tested over their entire circumference, except that when nondestructive testing is impracticable for a weld, it need not be tested if the number of welds for which testing is impracticable does not exceed 10 percent of the welds installed that day and shall include a sample from each welder per day;
- (a) Compressor Stations
  - (b) Class 3 locations
  - (c) Class 4 locations
  - (d) At crossings of major or navigable rivers
  - (e) Offshore
  - (f) Within railroad or public highway rights-of-ways, including tunnels, bridges, and overhead road crossings
- Note:** This requirement should encompass 100 feet (30.5 m) on each side of the railroad or public highway right-of-way.
- (5) For all remaining welds not identified in 7.6.2.2, 7.6.2.3 and 7.6.2.4, installed each day shall be 100 percent nondestructively tested over their entire circumference, except that when nondestructive testing is impracticable for a weld, it need not be tested if the number of welds for which testing is impracticable does not exceed 10 percent of the welds installed that day.
- Note:** This requirement encompasses both below grade and above grade piping and shall include a sample from each welder per day.
- (6) Station drain, water, oil, air, and other utility lines and vent piping of all sizes are to be nondestructively examined at a frequency determined by the Company.
- (7) Socket weld inspection to verify gap spacing implementation shall be as follows:
- (a) Proper gap spacing implementation is to be verified by the Company Authorized Representative through one of the following:
    - (i) Witnessing 100% of all gap spacing installation activities.
    - (ii) Perform 100% nondestructive testing by radiography of all socket welds.
    - (iii) Witnessing no less than 20% gap spacing installation activities in addition to performing nondestructive testing by radiography of no less than 20% of all socket weld installations. The socket welds selected to be nondestructive testing by radiography should not include any of the socket welds whose gap spacing installation activities were witnessed.

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Witnessing Examination (% of socket welds)	Radiography Requirements (% of socket welds)
100%	0%
20% ≥ & <100%	20%
<20%	100%

- (b) Witnessing gap spacing installation activities where Gap-A-Let® Ring (or similar) is utilized include all of the following:
- (i) Confirming appropriate nominal fitting size and Gap-A-Let® Ring or similar installation size are equal.
  - (ii) Observing seating of ring and insertion of pipe into fitting.
  - (iii) Observing welding until completion of root pass.
- (c) Witnessing gap spacing installation activities where manual scribe lines are utilized include all of the following:
- (i) Observe implantation of the scribe depicting the fully inserted pipe into the socket weld
  - (ii) Observe implementing of the scribe depicting 1/16<sup>th</sup> inch gap or greater
  - (iii) Prior to welding ensure appropriate fit-up to the 1/16<sup>th</sup> inch gap or greater scribe line
  - (iv) Observe implementation of the tack welds
  - (v) Observe welding until completion of root pass
- (d) Project documentation must clearly identify the socket weld inspection method that was utilized to verify gap spacing implementation as well as clearly demonstrate the execution of the required witnessing and/or nondestructive testing.

**7.6.3. Pipelines Constructed in Accordance with 49 CFR Part 195 or ASME B31.4**

- (1) For pipelines constructed in accordance with 49 CFR Part 195 or ASME B31.4, all of the nondestructive examination requirements identified in Section 7.6.3 must be completed.
- (2) Each circumferential girth/butt weld of steel pipe that is located where the stress during bending causes a permanent deformation in the pipe shall be nondestructively examined 100 percent after the bending process.
- Note:** This requirement applies to all pipe sizes and stress levels.
- (3) 100 percent shall be nondestructively tested for any of the following locations;
- (a) All tie-ins, including tie-ins of replacement sections.
  - (b) All old (preexisting) girth/butt welds shall be nondestructively tested when installing used pipe that contains existing girth/butt welds.
  - (c) Pre-tested pipe placed in the line.
- (4) All welds installed each day in the following locations shall be 100 percent nondestructively tested over their entire circumference, except that when nondestructive testing is impracticable for a weld, it need not be tested if the number of welds for which testing is impracticable does not exceed 10 percent of the welds installed that day and shall include no less than 10% per welder per day;

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- (a) At any onshore location where a loss of hazardous liquid could reasonably be expected to pollute any of the following locations:
  - (i) Streams
  - (ii) Rivers
  - (iii) Lakes
  - (iv) Reservoirs
  - (v) Other bodies of water
  - (vi) Any offshore area
- (b) Within railroad or public road rights-of-ways.
 

**Note:** This requirement should encompass 100 feet (30.5 m) on each side of the railroad or public highway right-of-way.
- (c) At overhead crossings and within tunnels.
- (d) Within the limits of any incorporated subdivision of a State government.
- (e) Within populated areas, including, but not limited to any of the following locations.
  - (i) Residential subdivisions
  - (ii) Shopping centers
  - (iii) Schools
  - (iv) Designated commercial areas
  - (v) Industrial facilities
  - (vi) Public institutions
  - (vii) Places of public assembly
- (5) For all remaining welds not identified in 7.6.3.2, 7.6.3.3 and 7.6.3.4, installed each day shall be 100 percent nondestructively tested over their entire circumference, except that when nondestructive testing is impracticable for a weld, it need not be tested if the number of welds for which testing is impracticable does not exceed 10 percent of the welds installed that day.
 

**Note:** This requirement encompasses both below grade and above grade piping and shall include no less than 10% per welder per day.
- (6) Socket weld inspection to verify gap spacing implementation shall be as follows:
  - (a) Proper gap spacing implementation is to be verified by the Company Authorized Representative through **one** of the following:
    - (i) Witnessing 100% of all gap spacing installation activities.
    - (ii) Perform 100% nondestructive testing by radiography of all socket welds.
    - (iii) Witnessing no less than 20% gap spacing installation activities in addition to performing nondestructive testing by radiography of no less than 20% of all socket weld installations. The socket welds selected to be nondestructive testing by radiography should not include any of the socket welds whose gap spacing installation activities were witnessed.

Witnessing Examination (% of socket welds)	Radiography Requirements (% of socket welds)
100%	0%

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20% $\geq$ & <100%	20%
<20%	100%

- (b) Witnessing gap spacing installation activities where Gap-A-Let® Ring (or similar) is utilized includes all of the following:
  - (i) Confirming appropriate nominal fitting size and Gap-A-Let® Ring or similar installation size are equal
  - (ii) Observing seating of ring and insertion of pipe into fitting
  - (iii) Observing welding until completion of root pass
- (c) Witnessing gap spacing installation activities where manual scribe lines are utilized includes all of the following:
  - (i) Observe implantation of the scribe depicting the fully inserted pipe into the socket weld
  - (ii) Observe implementing of the scribe depicting 1/16<sup>th</sup> inch gap or greater
  - (iii) Prior to welding ensure appropriate fit-up to the 1/16<sup>th</sup> inch gap or greater scribe line
  - (iv) Observe implementation of the tack welds
  - (v) Observe welding until completion of root pass
- (d) Project documentation must clearly identify the socket weld inspection method that was utilized to verify gap spacing implementation as well as clearly demonstrate the execution of the required witnessing and/or nondestructive testing.

**7.6.4. Piping Constructed in Accordance with ASME B31.3**

- (1) Piping constructed in accordance with ASME B31.3 that is within a B31.4 or B31.8 facility shall follow the minimum code requirements of ASME B31.3 Section 340 and 341.

**Note:** Such piping may consist of but is not limited to station drain piping, water, oil, air and other utility lines and venting piping of all sizes.

**7.7. Acceptance Standards for Nondestructive Examination****7.7.1. Pipelines Constructed in Accordance with 49 CFR Part 192, 49 CFR Part 195, ASME B31.8, or ASME B31.4**

- (1) The acceptability of a weld that is nondestructively or visually examined shall be determined according to API Standard 1104, Section 9.
- (2) If a girth weld is unacceptable under that standard for a reason other than a crack, and if the Appendix A to API Standard 1104 applies to the weld, the acceptability of the weld may be further determined under that Appendix A.

**7.7.2. Piping Constructed in Accordance with ASME B31.3**

- (1) The acceptability of a weld that is nondestructively or visually examined shall be determined in accordance with Table 341.3.2 of ASME B31.3.

**8.0 REPAIR OF WELDS**

- (1) Each weld that is unacceptable shall be removed or repaired.
  - (a) The Company Authorized Representative shall decide whether to repair or remove the defective weld.

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- (2) If repairs are permitted, the Company Authorized Representative shall specify the method of repair.
- (3) "Spot" repairs are not allowed. The minimum length of a repair weld is 3 inches (77mm).
- (4) Maximum length of any repair area and maximum number of repair areas shall be approved by the Company on a per project basis.
- (5) A minimum preheat of 200°F and maximum of 400°F shall be used for repair welding, unless otherwise specified in the WPS.
- (6) Repair of defects (first/single repair);
  - (a) Each weld that is repaired must have the defect removed down to sound metal.
  - (b) Defects may be removed using oxygen fuel gas gouging, plasma arc gouging, chipping, grinding, sanding, or filing.
    - (i) Carbon arc gouging is prohibited for field use.
      - (1) It may be used during shop fabrication provided that an additional  $\frac{1}{8}$  inch (3.2 mm) of metal is removed by grinding after carbon arc gouging.
    - (ii) When plasma arc gouging is utilized the repair gouged area shall be wire brushed to remove any oxide layer.
      - (1) It is preferred that an additional  $\frac{1}{16}$  inch (1.5 mm) of metal is removed by either grinding or sanding after plasma arc gouging.
      - (2) The Company Authorized Representative decides whether to wire brush and/or grind/sand the gouged area when plasma arc gouging is utilized.
  - (c) The repair shall be made using the original welding procedure, unless otherwise required per the prevailing construction code.
  - (d) The segment to be repaired shall be preheated if conditions exist which would adversely affect the quality of the weld repair, and/or when otherwise specified in the WPS.
  - (e) The repair shall be made under the supervision of a Company Authorized Representative experienced in repair welding techniques.
  - (f) After repair, the segment of the weld that was repaired shall be re-inspected to ensure acceptability using the original inspection method.
- (7) Repair of a previously repaired area and/or cracks;
  - (a) Cracks other than those permitted in API 1104 Section 9.3.10 or the prevailing construction code shall be removed from the line by cutting out the damaged weld as a cylinder.
  - (b) A defect in a previously repaired area shall be removed from the line; no additional repair welding shall be permitted.

## **9.0 REPORTING OF WELDING AND NDE ACTIVITIES**

- (1) Inspection is an ongoing process that provides an independent verification that the Contractor and Sub-Contractors have constructed the pipelines/facilities in accordance with all applicable Regulatory requirements, Company standards, and prevailing construction codes.
- (2) The effectiveness of the inspection program is maintained by reporting results of specific monitoring activities to the appropriate area of responsibility.
- (3) The Company Authorized Representative or Authorized Entity shall generate welding inspection reports on a daily basis using either;
  - A Company Inspection Form (See Appendix A) or,

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- A combination of inspection forms / documentation that captures the minimum required information as outlined in Section 9.4 (below).
- (4) The following sub-section identifies the minimum information to be captured / reported if the Company Inspection Form (See Appendix A) is not utilized on the project;
- Weather conditions that would impair weld quality
  - Visual inspection of pipe, piping components and materials on-site
  - Damaged or defects identified on piping, piping components or materials
  - Welding procedure specification(s) identified for work
  - Welder performance qualifications verified for work
  - Welding non-conformances identified
  - Visual inspection of girth welds
  - Visual inspection and NDE of sock-o-let type welds
  - Visual weld rejections identified
- (5) The Company's Inspection Forms (See Section 9.3) or similar documentation (See Section 9.4) will be used to provide a record of compliance as required per the various Regulatory requirements, Company standards, and prevailing construction codes.
- (6) The Company Inspection Department is responsible for conducting audits to ensure that the Company Inspection Forms or required information to be captured as outlined in Section 9.4 is completed from third-party vendors.
- (7) The Company Project Manager or their designee is responsible in ensuring the Company Inspection Forms or required information to be captured as outlined in Section 9.4, is captured and that such documentation is retained as defined in STD.0250.

## Appendix A    Company Inspection Form



Appendix A -  
Welding Inspector's

## Attachment Revision Log

Revision 3.0		Publish Date: 28 Jan 21
Location of Change	Type of Change	Reason for Change
Scope	Revision	Paragraph (5) was revised to clarify the Company Waiver process.
Section 1.0	Revision	Revised reference dates. Added STD.4600 to the 1.6 Company Standards.
Section 3.2	Update	Item 3 updated to reference Company Standards 4600 9.3 (4) & (5)
Section 3.2	Update	Socket joint welding requirements
Section 3.2	Update	Item 4
Section 3.2	Update	Item 11 updated to reflect 1/8"
Section 3.2	Delete	Item 15 removed statement allowing minimum number of welders as qualified by welding procedure specification.
Section 3.3	Update	Item 4
Section 3.5	Update	Item 1 added new requirements for SMAW welding
Section 4.0	Delete	Item 1 removed reference to silica deposits.
Section 4.0	Updated	Item 7 approval of clamping method.
Section 4.0	Addition	Item 9
Section 4.1	Removed	Figure 4-2, 4-3, 4-4 and 4-5.
Section 4.3	Updated	Item 3 tolerance on bevel angle updated to 2 ½ degrees
Section 5.0	Updated	Item 1 to include either Company or contractor procedures
Section 5.0	Updated	Item 2 to reference non Company procedures
Section 7.2.2	Updated	Item 3 to reference Company welding inspector.
Section 7.2.2	Addition	Item 4 added requirement for radiography of sock-o-lets
Section 7.2.3	Addition	Item 5 added requirement for radiography of sock-o-lets
Revision 4.0		Publish Date: 19 Aug 22
Location of Change	Type of Change	Reason for Change
Section 1.6	Revision	Incorporated several additional Company standard references.
Section 2.0	Revision	Several new definitions were incorporated and/or revised to support revisions elsewhere within the document.



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Section 3.2	Revision	Provided additional clarification for field and shop fabrication on number of passes showing on final passes, and minimum number of welders required.
Section 3.5	Revision	Provided additional clarification on several existing requirements for welding process restrictions.
Section 4.1	Revision	Provided additional clarification and requirements for the execution and inspection of transition welds.
Section 7.0	Revision	Provided additional clarification and modified requirements with respect to Company NDE requirements.
Section 9.0	Addition	New section for outlining reporting requirements of welding and NDE activities.
Appendix A	Addition	New Welding Inspection Report Form.