

1 0 SCOPE

- 1 1 This standard specifies the procedure for welding all API 5L 5LX ASTM A53 or A-106 grades of pipe material up to and including X60 on all natural gas facilities to comply with CPUC G O 112-D, Subpart E
- 1 2 The standard definitions contained in API Standard 1104 latest edition included in G O 112-D Appendix A shall apply to this standard
- 1 3 All procedures covered in this standard have been established and qualified in accordance with API Standard 1104
- 1 4 Any deviations from this welding standard shall be approved by the Gas System Design Department

2 0 WELDING PROCEDURE

2 1 Process

- 2 1 1 For pipe designed to operate at 20% or more of SMYS all butt welds shall be made by the shielded metal arc ~~gas~~ metal arc, or submerged arc welding process except piping in sizes 2 and under may be oxy-acetylene welded in accordance with Gas Standard D-20
- 2 1 2 For all stress levels pipe over 4 nominal size or 188 wall thickness shall be arc welded Smaller sizes and thinner walls may be arc welded

2 2 Method

Shielded metal arc welding of high pressure piping shall be performed according to Drawings 084022 and 086462 (Pages 9 and 10 of this standard)

2 3 Materials and Equipment

- 2 3 1 Welding electrodes shall conform to AWS Specification A 5 1 Refer to Pages 9 and 10 (Drawings 084022 and 086462)
- 2 3 2 All tools and equipment used in welding operations shall be of a capacity suited to the work for which they are employed
- 2 3 3 The welding operation must be protected from weather conditions that would impair the quality of the completed weld

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2 4 Weld Preparation

- 2 4 1 Prior to welding all dirt paint rust scale oil grease or other substance detrimental to welding shall be removed from the weld area **All machine cut bevels should be cleaned with a power driven grinder using either an abrasive disc or a wire wheel before welding All flame cut bevels should be ground with an abrasive disc before welding**
- 2 4 2 Before lengths of pipe are welded together all loose rust debris and dirt shall be removed from the inside of the pipe by swabbing or other acceptable method The lineup foreman or other responsible person shall visually inspect the inside of each pipe section before the pipe is aligned to insure compliance with this requirement
- 2 4 3 The pipe shall be aligned to minimize the offset between joint surfaces For pipe of the same nominal wall thickness the offset shall not exceed 1/16 If the pipe or pipe ends are defective or damaged (scratches gouges dents etc) the end shall be rebeveled
- 2 4 4 All hammers used for aligning pipe must be faced with bronze or brass Care shall be exercised to avoid abrasions on pipe
- 2 4 5 When unequal thicknesses are joined by welding the external offset shall not exceed 1/8 inch and internal offset shall not exceed 3/32 inch If these values are exceeded the unequal thickness shall be treated as shown on Drawing 084033 (Page 8 this Standard)
- 2 4 6 Longitudinal pipe welds shall be staggered within the top quadrant except for bends The longitudinal seam at bends shall be in the neutral axis --never in compression or tension
- 2 4 7 A lineup clamp shall be used on pipe sizes 3 and greater Lineup clamp shall be left in place until the stringer bead is at least 50% completed in equally spaced segments Care must be taken to insure that no stress is placed on the weld joint until the stringer bead is completed
- 2 4 8 Minimum separation between any welds shall be
 - 2 4 8 1 One pipe diameter for welds on pipelines other than station piping (Design Pres 20% or more of SMYS)
 - 2 4 8 2 2 for station piping or fabricated assemblies (Design Pres 20% or more of SMYS)
 - 2 4 8 3 1 across throat of sections of 2 or larger elbows (G O 112-D & 192 213 (c))
- 2 4 9 Adequate working clearance (size of bell hole etc) shall be provided around the pipe at all points to be welded

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2 5 Preheating

- 2 5 1 All pipe having a wall thickness greater than 0 500 inch or having a carbon content in excess of 0 32 percent or a carbon equivalent (C + $\frac{1}{4}$ Mn) in excess of 0 65 percent (pipe meeting API 5L or 5XL does not exceed these limits) shall be preheated to between 200°F and 400°F prior to and during welding
- 2 5 2 All pipe shall be preheated to between 200°F and 400°F when the pipe temperature is less than 50°F
- 2 5 3 The preheat area shall be at least six inches wide centered about the weld and shall extend around the entire circumference of the pipe
- 2 5 4 Preheat temperatures shall be checked with temperature-sensitive crayons such as Tempilstick or by other approved methods

2 6 Stress-Relieving

- 2 6 1 Stress-relieving shall be required under the following conditions
- 2 6 1 1 When the carbon content of the pipe material by ladle analysis exceeds 0 32 percent or the carbon equivalent (C + $\frac{1}{4}$ Mn) exceeds 0 65 percent (pipe meeting API specifications 5L or 5LX does not exceed these limits)
- 2 6 1 2 When the wall thickness of the pipe being welded is 0 750 inch or greater unless approval by GSDD and is mandatory for all thickness 1-1/4 inch or greater
- 2 6 1 3 When couplings weldolets or socket-weld fittings larger than two inches are welded to a header wall thickness 0 750 inch or greater unless approved by Gas System Design Department
- 2 6 2 Stress-Relieving Temperature
- 2 6 2 1 For welding being performed under API specifications as in this Standard heating to stress-relieving temperatures shall be done uniformly at a rate suitable to the type of equipment being used For welds to ASME specifications heat uniformly at a rate not to exceed 600°F per hour below 600°F and not to exceed 400°F per hour above 600°F
- 2 6 2 2 The weld being stress-relieved shall be held in the range of 1100°F - 1200°F for a period of one hour per inch of wall thickness but in no case less than 45 minutes

2 6 2 3 After stress-relieving is completed the weld shall be cooled to 600°F at a cooling rate not to exceed 500°F per hour From 600°F the weld may be cooled in still air Accelerated cooling is not allowed

2 6 2 4 The minimum width of the area to be heated on each side of the weld shall be equal to four times the wall thickness or two inches whichever is greater

2 6 3 Equipment for Local Stress-Relieving

2 6 3 1 Stress-relieving may be accomplished by electric induction electric resistance ~~oxyfuel~~-fired ring burners exothermic chemical reactions or other suitable means of heating in compliance with Para 2 6 2 of this Standard

2 7 Position Welding - Arc Welding (For low hydrogen electrodes also see additional requirements in Section 2 8)

2 7 1 Welding Procedure (Also see Page 9 Drawing 084022)

2 7 1 1 All position welds made with EXX10 and EXX11 electrodes shall be performed by the downhill method

2 7 1 2 Striking an arc on the pipe will not be permitted except in the welding groove

2 7 2 Root Bead and Hot Pass

The amount of space between pipe ends should be established to suit the preference of the welder responsible for the integrity of the root bead Care must be taken to obtain proper penetration without burn through

The root bead must be thoroughly cleaned and the hot pass (second bead) made in a manner that will provide a clean base for the subsequent filler beads All humps in tacks and stringer beads should be ground down prior to hot pass Also if wagon tracks are too deep in some areas the hump in the center of the stringer should be ground down



Wagon tracks - can be difficult to penetrate if hump on bead too high
(Crevice-Slag Filled)

* The hot pass shall be made as soon as possible after the root bead This is particularly important for larger heavy wall pipe The hot pass and/or fill pass(es) shall always be made before the incomplete weld is allowed to sit overnight or removal of pipe support, to prevent cracking of root bead

*Revised Paragraph

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2 7 3 Filler and Cover Passes

- * 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. At no point shall the crown surface be below the outside surface of the pipe nor should it be raised above the parent metal more than 3/32 inch.
- * On heavy wall pipe where the welding groove is wider than normal **more than one bead per layer** shall be used for filling and capping in the downhill direction (does not apply to low hydrogen electrodes --see Section 2 8 2) Exceptionally wide downhill wash passes shall not be permitted.
- * Two beads shall not be started at the same location. The face of the completed weld should be approximately 1/8 to 3/16 inch greater than the width of the original groove. The completed weld shall be thoroughly brushed and cleaned.

2 7 4 Pipe 16 and Over

On pipe 16 and over the stringer bead should be completed by two welders working in opposite quadrants of the pipe. When only one welder is available for maintenance work on pipe 16 and larger the welder shall complete the stringer in one quadrant and then move to the opposite quadrant making sure that he maintains even heat distribution.

2 8 Position Welding - Low Hydrogen Electrodes

Special considerations for handling and welding with low hydrogen rods are as specified. Also see Page 10 (Drawing 086462) Refer to Section 2 7 for general welding procedures.

2 8 1 Welding Rod

- 2 8 1 1 Welding rod shall conform to AWS classification EXX16 or EXX18 electrode. The diameter of these electrodes should not exceed 1/8 inch.
- 2 8 1 2 Low hydrogen electrodes must be stored and handled in a manner to prevent absorption of moisture. The low hydrogen manufacturers pack the electrodes in sealed moisture proof containers. After this seal is broken the electrodes shall be removed from the manufacturers containers and placed in a suitable electric holding oven at minimum 250° maximum 400° F. The 250° minimum shall be maintained consistently for the duration of the job.
- 2 8 1 3 Electrodes which have been exposed to moisture conditions or have been removed from the holding oven for a length of time exceeding 8 hours shall be disposed of.

*Revised Paragraph

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2 8 1 4 All welders qualified to use this type electrode shall be thoroughly instructed in its storage and handling requirements shall be equipped with a holding oven or electrode warmer and shall insure that the electrodes are not exposed to moisture

2 8 2 Welding Techniques

* 2 8 2 1 Root bead and hot pass shall be made as specified in Par 2 7 2 using E-6010 electrodes for pipe up to X-46 Use E-7010 electrodes for pipe over X-46

2 8 2 2 Filler and cover passes are made with low hydrogen electrodes using the uphill method only (except on vertical fixed pipe where horizontal beads are used)

* 2 8 2 3 On heavy wall pipe where the welding groove is wider than normal more than one bead per layer shall be used for filling and capping Exceptionally wide wash passes will not be permitted

2 8 2 4 Clean each bead thoroughly (Low hydrogen electrodes will not burn out entrapped slag or other impurities as well as the EXX10 series electrodes)

2 8 2 5 For low hydrogen electrode classification size, and current required for fillet welds see Drawing 086462 (Page 10)

2 8 3 Welder Qualification

2 8 3 1 Welder shall be qualified, in accordance with Gas Stds D-30 & D-30 2 to weld on API 5L and 5LX grade pipe using the techniques described in Par 2 8 2

2 9 Roll Welding

2 9 1 Maintaining Alignment

At the option of the Company roll welding will be permitted providing alignment is maintained by use of supports to prevent sagging at the welding joint

2 9 2 Root Bead, Hot Pass Filler Beads and Cover Pass

The requirements of Section 2 7 shall apply except that the second or hot pass shall be made immediately following the first or stringer pass and before the weld metal cools below 100°F

2 10 Horizontal Welds

When shielded metal arc welds are made with the pipe in an approximately vertical position the deposition of weld metal shall be in successive

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passes deposited as multiple beads in an approximately horizontal plane. The cover passes shall also be deposited as beads. Wash passes shall not be permitted.

2 11 Fillet Welds

- 2 11 1 All fillet welds shall be flat and the length of each leg approximately equal. All fillet attachment welds shall be in accordance with Drawing 283263 (Page 11 this Standard).
- 2 11 2 When slip-on flanges are welded to pipe the inside weld shall be made first followed by the weld at the reverse or back side of the flange as shown on Drawing 283263 (Page 11 this Standard).
- 2 11 3 Fillet welds attaching supports and other nonpressure attachments to pressure piping are limited to pipe under API 5LX Gr X46 specification and operating under 50% of SMYS and shall not exceed $3/8$ leg size and 2 in length.

2 12 Backwelding When Joining Unequal Wall Thicknesses

- 2 12 1 Backwelding and end preparation when joining unequal wall thicknesses shall be performed as specified on Drawing 084033 (Page 8 of this Standard). When backwelding the first pass should be a hot pass using 6010 or 7010 see Page 9 (Drawing 084022) (maximum $5/32$ diameter rod) to clean any slag or other impurities from the root bead. When backwelding with cellulose electrodes where more than one pass is necessary $3/16$ diameter electrodes may be used after the hot pass. Backweld passes shall be made by the downhill method of welding (no undercutting permitted).
- ** 2 12 2 When valves and fittings are welded to each other or to pipe the joint shall have a two pass weld on the inside in addition to the outside weld. This requirement applies to all welds on pipe 16 diameter and larger and to smaller diameters when practical.
- 2 13 Where the number of welders makes identifying a welder's work difficult or uncertain the welder shall identify his work by making with soapstone, yellow lumber crayon or other suitable marker. Welders should be assigned numbers or initials for identification.

** Added Paragraph

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