1. Scope

A. This standard shall be included as a part of all Welding Procedure Specifications used on natural gas facilities governed by CPUC GO 112 (latest revision), Subpart E and the edition of API Standard 1104 code referenced in Appendix A of GO 112.

B. Material to be welded by procedures given in this standard includes the following:

1. Pipe: API 5L, Gr.B & A–25
   API 5LX, Gr. X–42 up to and including X–65
   ASTM A–53, Gr.B
   ASTM A–106, Gr. B
2. Fittings: ASTM A–516, Gr.70
   ASTM A–242
   ASTM A–441
   ASTM A–633, Gr.E
   ASTM A–234, Gr.WPB
   ASTM A–105

Any exceptions shall be noted in the particular welding procedure specification.

C. All welding on pipe and fittings that are not under pressure shall be done using detailed procedure specifications established, qualified, and recorded in accordance with GO–112 and the API 1104 code.

D. Changes to these welding standards shall be approved by the responsible department.

2. Welding Specifications

A. Weld Procedure Selection

1. Prior to the welding of pipe or fittings the welder must first identify the pipe size, type of material that is to be welded (specified minimum yield strength), and stress level for which the pipe is designed to operate. The appropriate welding process and procedure shall be determined from Paragraphs 2.1.2. through 2.1.6 below.
2. All piping, fittings and appurtenances designed to operate at 20% or more of the pipe SMYS, regardless of size, shall be welded by using one or a combination of the following processes:
   (a) Shielded metal arc welding (SMAW) (See Gas Std. D–30.2 for qualification procedure).
   (b) Gas metal arc welding (GMAW)
   (c) Flux cored arc welding (FCAW)
   (d) Gas tungsten arc welding (GTAW)
   (e) Submerged arc welding (SAW).
3. This standard covers the SMAW process using cellulose and low–hydrogen electrodes and GMAW for all stress levels
4. SMAW and GMAW shall be the preferred welding processes used for all piping larger than 2" nominal diameter with a wall thickness greater than 0.154" and designed to be operated at over 20% SMYS.
5. Oxy–acetylene gas welding, in accordance with Gas Standard D–20, may be used instead of SMAW or GMAW under the conditions listed in paragraphs 2.1.1 and 2.1.2 of Gas Std. D–20.
6. Piping designed to operate at less than 20% SMYS may be welded using any of the arc welding processes listed in Paragraph 2.1.2 above.
7. GMAW is the preferred process for making branch connection welds. If SMAW process is used, the procedure for welding branch connections shall be to use cellulose electrodes for the first and second passes followed by low–hydrogen electrodes for the filler and cover passes.
8. Welding on pipe greater than 12 inches in diameter (nominal) shall be welded simultaneously by a minimum of 2 welders on opposite sides of the pipe. If this is not possible, the single welder shall weld one quadrant (1/4 of circumference) at a time, moving to the opposite quadrant after each pass, and welding the opposite quadrant to offset expansion/contraction stresses due to welding.

B. Weld Preparation

1. Welding electrodes shall conform to AWS Specification A–5.1, A–5.5 or A–5.18. Refer to Drawings 284361 and 284363 of this standard.
2. All tools and equipment used for welding shall be of a capacity suited to the work to be performed.
3. The welding operation must be protected (shielded) from weather conditions (rain, snow, ice, or high winds) that would impair the quality of the completed weld.
4. Prior to welding, the weld groove and the adjacent surfaces 1" from it shall be cleaned

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5	Retyped; modified paragraphs 1.D, 2.A.5, 2.A.8, 2.E.2.5, 2.F.8.(b), and 2.H.2	[redacted]	10-12-92

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ARC WELDING PROCEDURE REQUIREMENT ALL STRESS LEVELS

GAS TRANSMISSION

DOCUMENT NUMBER – PAGE

086432 1

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and kept free of all dirt, paint, rust, scale, moisture, oil, grease, or other foreign material harmful to welding. Clean by filing, hand or power wire brushing or grinding, and approved solvents. Acceptable solvents for cleaning and drying are alcohol (methanol or ethanol) or acetone. Do not expose these solvents or their fumes to open flame, arcs, or hot surfaces.

5. Before sections of pipe and fittings are assembled for welding all rust, scale, slag, dirt, liquids, or other foreign matter shall be removed from the inside surface of the pipe by swabbing with clean rags or by other acceptable methods. Responsible person(s) on the job shall insure compliance with this requirement.

6. Pipe and/or fittings joined by welding shall be aligned to minimize any offset (high–low) of pipe wall surfaces around the circumference of the pipe. For joining pipe and/or fittings of the same nominal wall thickness, the internal offset shall not exceed 1/16". If the pipe or fitting ends are defective or damaged (scratches, gouges,dents, etc.), the ends shall be rebeveled. For joining pipe of unequal wall thickness, the internal offset shall not exceed 3/32". If this value is exceeded, refer to Drawing 084033 of this standard. External offset shall be limited to the out–of roundness and pipe and fitting end diameter tolerances given in the material specifications.

7. All hammers used for aligning pipe and fittings must be bronze or brass faced. Care should be exercised to avoid denting, gouging, or scratching the pipe and/or fittings.

8. When aligning abutting lengths of pipe for welding, the longitudinal seams shall be staggered, (no closer than 3") within the top quadrant (10 to 2 o'clock).

9. A lineup clamp shall be used on pipe with a nominal diameter 3" or larger. The lineup clamp shall be left in place until the stringer bead is at least 50% completed and equally deposited around the weld groove. No stress (movement) shall be placed on the weld groove until the stringer bead is completed (applicable only when piping meets <u>both</u> of the following criteria: a) Grade X52 or above; (b) 12.750–inch O.D. or larger).

   (a) The minimum separation between any two circumferential welds, wherever possible, shall be:

      (i) One pipe diameter for welds on pipelines other than station piping but never less than 3 inches (except as allowed by paragraph 2.2.10.3 below).

      (ii) Six inches for station piping or fabricated assemblies 6" nominal O.D. and larger; one pipe diameter for piping smaller than 6" nominal O.D.

      (iii) One inch, as measured along the inside arc radius of any welding elbow and transverse segments of these elbow 2" or more in nominal diameter (GO 112, latest revision, paragraph 192.313 (c)).

   (b) Adequate working clearance shall be provided and maintained around the pipe and/or fittings at all points to be welded so that the work can be performed safely.

   (c) Branch connection welds including reinforcing member welds, shall be located at least 3" away from circumferential welds whenever possible.

C. Preheating

1. A preheat of 200°F minimum to 400°F maximum must be achieved and maintained at the weld location until completion of welding when any of the following conditions exist:

   (a) When pipe or fitting wall thickness (regardless of pipe grade) is <u>greater than</u> 0.500".

   (b) When the pipe or fitting surface temperature at the weld area is less than 50°F.

   (c) When the pipe mill heat analysis shows a carbon content in excess of 0.32%.

   (d) When carbon equivalent, C.E. (C.E.% = carbon % + 1/4 manganese %), exceeds 0.65%.

   <u>Note:</u> Pipe material meeting API 5L, 5LX and ASTM A–53 or A–106, Gr.B

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ARC WELDING PROCEDURE REQUIREMENT
ALL STRESS LEVELS

GAS TRANSMISSION

DOCUMENT NUMBER – PAGE

086432 2

Converted to Interleaf

specifications does not exceed the above chemical limits required for preheat. Certain fitting materials may exceed the limits and therefore would require preheat.

(e) When weld defects are being repaired.

2. The preheated area shall be at least six inches wide, centered about the weld, and shall extend around the entire circumference of the pipe or fitting.

3. Preheat temperature shall be checked with temperature sensitive crayons, such as "Tempilstick", or contact pyrometer, at the weld area, outside of the weld groove.

4. If welding is interrupted, the weld area shall be preheated before welding is resumed.

5. Interpass temperature is the temperature of the weld area between depositing weld beads. Minimum interpass temperature shall comply with minimum preheat temperature requirements given in 2.3.1 preceding.

D. Stress Relieving

1. Stress relieving shall be required under the following conditions:

(a) When the carbon content of the pipe fitting material by heat analysis exceeds 0.32% or the carbon equivalent (C + 1/4 Mn) exceeds 0.65% (Pipe meeting API specifications 5L or 5LX and ASTM A–53 or A–106, Gr. B does not exceed these limits. Certain fitting materials may exceed these limits and therefore would require stress relieving.)

(b) When the wall thickness of the pipe or fitting being welded is 0.750" or greater, unless low hydrogen or GMAW welding processes are used. Stress relieving is mandatory for all thickness 1–1/4" or greater.

(c) When couplings, weldolets, or socket–weld fittings larger than 2" are welded to a header wall with a thickness 0.750" or greater, unless low hydrogen or GMAW welding processes are used. Stress relieving is mandatory for all header wall thickness 1–1/4" or greater.

2. Stress Relieving Temperature

(a) 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.

(b) 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.

(c) 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.

(d) The minimum width of the area to be stress relieved on each side of the weld shall be equal to four times the wall thickness, or two inches, whichever is greater.

3. Equipment for Local Stress Relieving

(a) Stress relieving may be accomplished by electric induction, electric resistance, oxy–fuel–fired ring burners, exothermic chemical reactions, or other suitable means of heating in compliance with Paragraph 2.4.2 of this standard.

(b) The stress relieving temperature shall be checked by the use of recording thermocouple pyrometers. Recording charts shall be properly identified and become part of the job records.

E. Horizontal and Vertical Fixed Position Welding – Cellulose–Type Electrode or Wire Type Electrode for GMAW

Horizontal and vertical fixed position shielded metal–arc welding with cellulose–covered electrodes (AWS E6010, E7010, or E8010) or wire electrode (ER70S–6) shall be performed by the "downhill" method. Refer to Drawing 284361 for the proper electrode to use with specific materials.

1. Depositing Stringer Bead and Hot Pass

The amount of root opening (gap) shall fall within the range given on Drawing 284361

for the welding process used, and should suit the preference of the welder responsible for the integrity of the stringer bead. During alignment and tacking, the joint is held together by a lineup clamp. Care must be taken during joint alignment and preparation to ensure full penetration and complete fusion during stringer bead (root pass) deposit.

Strike the arc in the weld groove only. The stringer bead for SMAW is made using a drag technique (electrode coating resting on the bevel as the electrode is dragged downhill). Thoroughly clean the stringer before applying hot pass (second bead). Disc grinding is used to remove bumpy starts and slag, improve bead contour, or remove excessive wagon tracks before applying the hot pass.

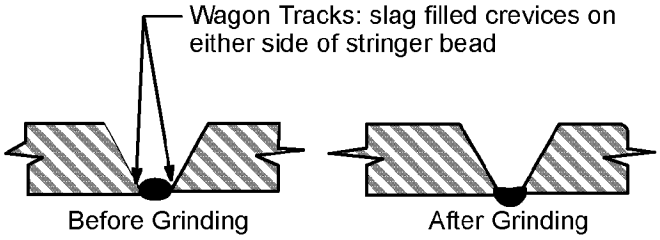

Fig. 1

Applying the hot pass with sufficient heat (amperage) will melt out shallow wagon tracks and float any remaining slag to the surface. Use a slight up and down whipping motion. Start the hot pass immediately after completion of the stringer bead – within five minutes.

2. Filler and Cover Passes

   (a) A side–to–side weave motion is used when applying the filler passes. Filler metal shall be added to any concave portion of the filler passes, before applying the cover pass.

   (b) On heavy wall pipe and fittings (greater than schedule 40) where the welding groove is wide, more than one bead per layer shall be used for filling in the "downhill" direction (does not apply to low hydrogen electrodes – see Section 2.6.8.2).

   (c) Strip capping shall be used for making the cover pass when welding in the vertical fixed position. Wash passes are not acceptable when welding in this position.

   (d) Filler and cover passes made using the weave motion when welding downhill on horizontally fixed pipe and fittings shall be no wider than four times the electrode diameter. Welds shall be uniform and without undercutting.

   (e) Two beads shall be started at the same location. The face of the completed weld should be approximately 1/8 inch greater than the width of the original groove. 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 1/16 inch.

   (f) The completed weld shall be thoroughly brushed and cleaned.

F. Horizontal and Vertical Fixed Position Welding – Low–Hydrogen Electrodes (See Note 4 on Drawing No. 284363 for recommended use)

1. To perform properly, low hydrogen electrodes must be stored and handled in a manner which will prevent absorption of moisture. These electrodes shall either be stored in their manufacturer's unopened containers, or once opened, in holding ovens. Electrodes in unopened sealed containers remain dry indefinitely under good storage conditions. The storage area should be enclosed, clean, dry and have adequate facilities for safe storage to prevent deterioration.
2. If used immediately, low–hydrogen electrodes may be issued for use directly from freshly–opened hermetically sealed containers. The remaining electrodes shall be removed from their containers and placed in an electric holding oven or portable rod warmer and held at a temperature of 250°F to 350°F.
3. Electrodes shall be withdrawn from the holding oven or portable rod warmer in small quantities and used immediately.
4. The electric holding oven or portable rod warmer shall be powered by a reliable electric source.
5. Electrodes shall not be exposed to moisture. They shall not be used after having been

removed from their sealed containers or holding oven for a period exceeding four hours. If the low–hydrogen electrode container is punctured and exposed to air for a few days, or stored sealed for long susperiods of time in areas of high humidity, weld quality will be adversely affected.

6. Electrodes subjected to the conditions described in paragraph 2.6.5 must be dried or discarded. Electrodes are dried by baking them in an electric oven at 700°F to 800°F for a minimum of one hour. They should then be transferred to a holding oven and held there until used. Discard any electrodes whose coating becomes fragile and discard any electrodes and flakes or breaks off while welding or that develops a noticeable difference in handling or arc characteristics.

7. All welders who become qualified to use low–hydrogen electrodes shall be thoroughly instructed in storage and handling requirements and be equipped with an electric heater or portable electrode warmer. Low–hydrogen electrodes shall always be issued in portable rod warmers, or the electrodes shall be returned to the heated storage oven within the time specified in par. 2.6.5.

8. Welding Technique with Low–Hydrogen Electrodes. (refer to drawing 284363)

   (a) The stringer bead and hot pass shall be made using shielded metal–arc welding with E6010(5P), E7010(HYP) or E8010(70+) electrodes, welding downhill, on horizontally fixed pipe and fittings.

   (b) Filler and cover passes shall be made using E7016 or E7018 electrodes for all grades of pipe through X–60, and E8016 or E8018 electrodes for X–65 pipe, welding uphill, on horizontally fixed pipe and fittings.

   (c) On heavy wall pipe or fittings (greater than schedule 40) where the welding groove is wide, more than one filler and/or cover pass per layer shall be used.

   (d) Filler and cover passes made using the weave motion welding uphill on horizontally fixed pipe and fittings shall be no wider than 5/8" using 3/32" diameter rod and 1" using 1/8" diameter rod.

   (e) On pipe or fittings in the vertical fixed position, each weld layer shall be deposited with multiple passes in the horizontal plane. Wash passes shall not be permitted.

G. Roll Welding

Roll or flat welding is where the welding arc is struck on the top of the pipe or fitting and held there to deposit the bead as the pipe or fitting is steadily revolved. When applicable, roll welding will be permitted, providing alignment and support is maintained by roll–type positioners.

H. Fillet Weld

The bead shape of all fillet welds shall be flat or slightly convex with the length of each weld leg equal. All attachments using fillet welds shall be in accordance with Drawing 283263 sheet 2 of 2 of this standard.

Circumferential fillet welds on sleeves shall be made using all low–hydrogen electrodes or GMAW if the preheat temperature specified in paragraph 2.3.1 cannot be maintained (e.g. flow cannot be made static). If the preheat temperature specified in paragraph 2.3.1 can be maintained, then circumferential fillet welds shall be made using the procedure described in paragraph 2.6.8 above or using a qualified GMAW process.

1. When welding slip–on flanges to pipe, the inside weld joining the pipe end to the flange's inside diameter bore surface shall be completed first, followed by the weld at the outside of the flange to the outside circumference of the pipe as shown on Drawing 283263, sheet 2 of 2.

2. Fillet welds attaching supports and other non–pressure attachments to pressure piping are limited to piping and fitting materials with less than 46,000 psi SMYS operating under 50% of SMYS and shall not exceed 3/8" leg size and 2" in weld length. It is not recommended to weld supports of other non–pressure attachments directly to pressure piping.

I. Back–welding

1. Back–welding and end preparation when joining unequal wall thickness shall be performed as specified on Drawing 084033 of this standard. Before back–welding, disc

grind or wire buff loose scale from the backside of the weld groove.

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 diameters when practical. Back–welding is not required if valves and fittings are supplied shop welded to pipe of the same wall thickness as the line pipe.

3. Back–welding shall be done using SMAW welding with E6010, E7010, or E8010 electrodes. Use a small weave to penetrate and fuse the backside of the weld groove. Back–weld bead width and height should exceed minimum requirements shown on Drawing 084033 by as small a margin as practical. If a second fill pass is needed, this pass should form a smooth transition from one side of the pipe to the other. Do not overweld.

J. Repair or Removal of Defects and Cracks

1. Repair welds shall be performed using a written, qualified weld repair procedure.

   (a) Prior to welding, the surfaces to be welded shall be cleaned and prepared in accordance with the requirements given in this standard.

   (b) With the exception of shallow crater cracks, no weld containing cracks, regardless of size or location shall be acceptable. All welds containing cracks and other unacceptable defects that are detected during or after welding shall be repaired or removed. Cracks in circumferential or branch connection welds that are more than 8% of the weld length, must be repaired by replacing a pipe segment. Cracks of any length in longitudinal welds in pipe operating with an MAOP of 20% or more of SMYS or 500 psig or greater, must be repaired by replacing a pipe segment. Cracks in longitudinal welds in pipe operating with an MAOP below 20% of SMYS or 500 psig may be repaired using the patching, sleeving or canning repair methods given in Gas Standard A–65.

   (c) f a longitudinal or branch connection weld has a crack that is 8% or less of the weld length, the weld may be repaired by grinding, filing or machining the repair cavity to bright clean base metal, and fill welding. Refer to Gas Standard A–65 for other permissible repair methods. Oxy–fuel gas gouging (flame gouging), air carbon–arc gouging, and chipping are acceptable methods for removing cracks and other defects, except only grinding or chipping should be used on pressurized lines. After removing defect(s), other than cracks, the area shall be examined visually to verify that the defect(s) have been completely removed. After removing crack(s) the repair groove must be examined by a magnetic particle or dye penetrant test to assure complete removal of the crack(s). The surface of the fill weld must conform to the surface of the adjacent original weld.

2. A replacement segment of pipe must be installed with the minimum separation between welds given in paragraph 2.2.

3. Preheating of the segment(s) to be repaired is required per paragraph 2.3 if conditions exist which would adversely affect the quality of the weld repair. Post–weld heat treatment, and nondestructive examination shall be the same as required for the original weld joint.

4. Repair of a crack, or of any defect in a previously repaired area must be in accordance with written weld repair procedures that have been qualified under Gas Standards D–30, D–30.1 or D–30.2. Repair procedures must provide that the minimum mechanical properties specified for the welding procedure used to make the original weld are met upon completion of the final weld repair.

5. Arc burns shall be either repaired by grinding or cut out. If a repair is made by grinding, the remaining wall thickness must at least be equal to either:

   (a) The nominal wall thickness required for the design pressure of the pipeline, or

   (b) The minimum wall thickness required by the tolerance in the specification to which the pipe was manufactured. The amount of allowable wall thickness reduction based upon the manufactured pipe specifications is as follows:

   12–1/2% for ASTM A–106 pipe
   10% for API–5L pipe

REV.	DESCRIPTION	APPROVED BY	DATE
5	Retyped; modified paragraphs 1.D, 2.A.5, 2.A.8, 2.E.2.5, 2.F.8.(b), and 2.H.2	[redacted]	10-12-92

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ARC WELDING PROCEDURE REQUIREMENT
ALL STRESS LEVELS

GAS TRANSMISSION

DOCUMENT NUMBER – PAGE

086432 6

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8% for API–5LX pipe
12–1/2% for ASTM A–53 pipe

K. Identification of Welds

Where the number of welders makes identifying a welder's work difficult, the welder shall identify his work by marking it with his assigned number or initials using soapstone, yellow lumber crayon or other suitable marker.

REV.	DESCRIPTION	APPROVED BY	DATE
5	Retyped; modified paragraphs 1.D, 2.A.5, 2.A.8, 2.E.2.5, 2.F.8.(b), and 2.H.2	[redacted]	10-12-92

PG&E

ARC WELDING PROCEDURE REQUIREMENT
ALL STRESS LEVELS

GAS TRANSMISSION

DOCUMENT NUMBER – PAGE

086432 7

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This joint design not for use where thicker pipe wall has lower yield strength. A joint of this type could be used where location class changes.

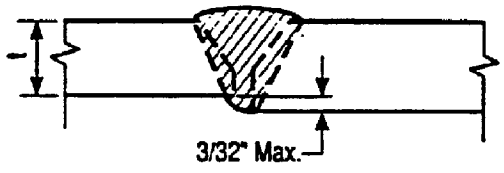

Figure A

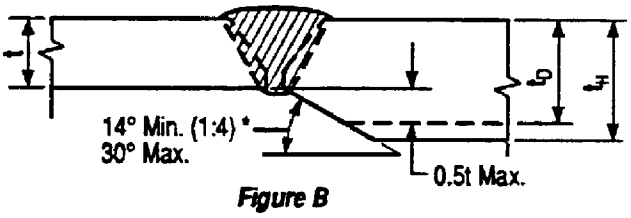

Figure B

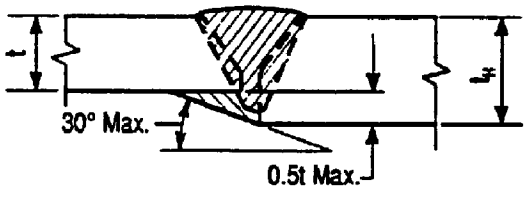

Figure C

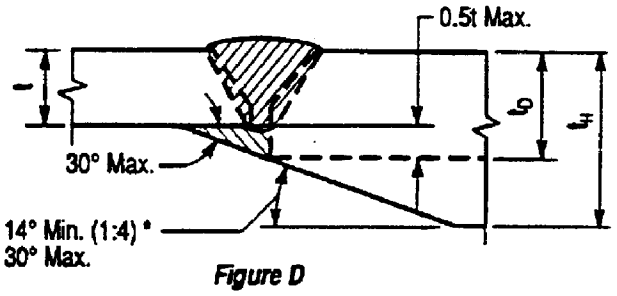

Figure D

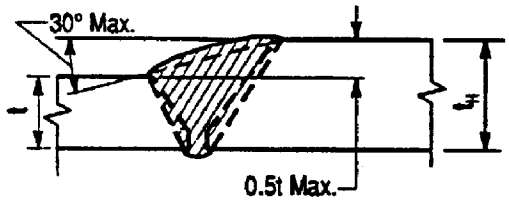

Figure E

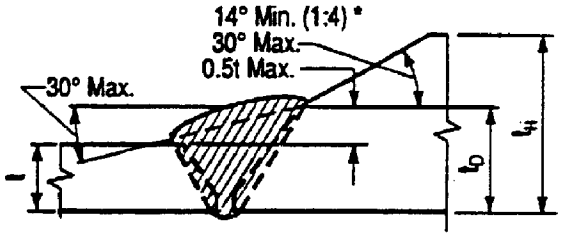

Figure F

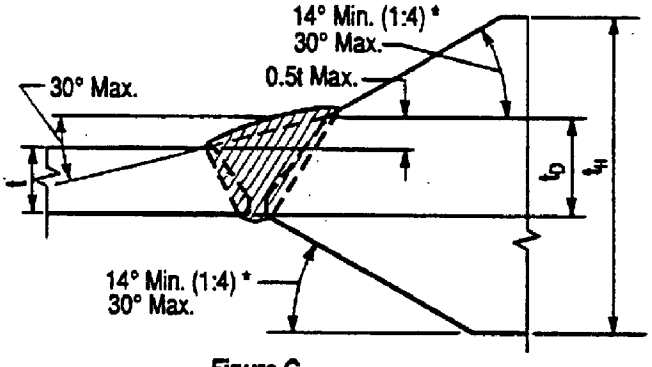

Figure G

t_D = Wall thickness required for design purposes for heavy wall pipe which is being joined to thinner pipe. t_D may not exceed 1.5t.

t_H = Actual wall thickness of heavier wall pipe.

* = No minimum when materials joined have equal yield strength.

NOTE:

1. If materials being joined have yield strengths with a ratio of higher yield to lower of 1.5 or greater, it is recommended that a transition piece of intermediate yield strength be used. Welding electrodes must be suitable for the highest yield material in each joint.

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GAS & ELECTRIC DISTRIBUTION DEPARTMENT - DISTRIBUTION STANDARDS

PIPING - DATA SHEET

END PREPARATIONS FOR JOINING UNEQUAL WALL THICKNESSES

GAS DISTRIBUTION

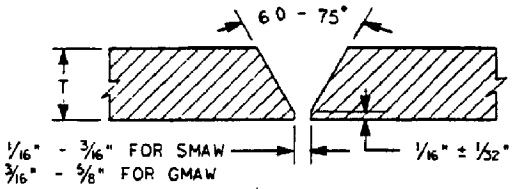
DRAWING NUMBER - SHEET

084033 1

D-22

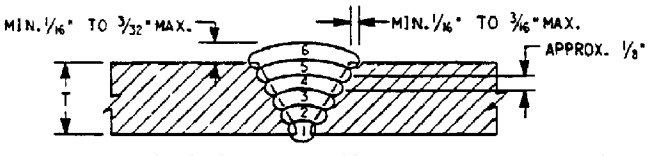
PAGE 14

WELD DESIGN



FOR GAPS WIDER THAN 1/4" WELD SHALL BE MADE BY A WELDER QUALIFIED FOR A WELD PROCEDURE USING AT LEAST 1/2" GAP.

STD. "V" BEVEL BUTT JOINT



SEQUENCE OF BEADS (NUMBER WILL VARY WITH CHANGE IN WALL THICKNESS, ETC)

TABLE 1
SUITABLE ELECTRODES FOR WELDING VARIOUS MATERIALS

MATERIAL	ELECTRODE	
PIPE (SEE NOTE 4)	AWS A-5.1&5.5 SMAW	AWS A-5.18 GMAW
API 5L, GR. B & A-25	E 6010	ER70S-6
API 5LX, GR. X-42 THRU X-48	E 6010	ER70S-6
API 5LX, GR. X-52 THRU X-60	E 7010	ER70S-6
API 5LX, GR. X-65	E 8010	———
ASTM A-53, GR. B	E 6010	ER70S-6
ASTM A-106, GR. B	E 6010	ER70S-6
FITTINGS		
ASTM A-105	E 6010	ER70S-6
ASTM A-234, GR. WPB	E 6010	ER70S-6
ASTM A-242 & A-441	E 6010	ER70S-6
ASTM A-516, GR. 70	E 6010	ER70S-6
ASTM A-633, GR. E	E 7010	ER70S-6

WHERE FITTINGS ARE TO BE WELDED IN PIPELINES, AND THE SUITABLE ELECTRODES AS GIVEN IN TABLE 1 ARE DIFFERENT, USE THE HIGHER STRENGTH ELECTRODES (I.E. E 7010 INSTEAD OF E 6010 OR E 8010 INSTEAD OF E 7010).

WELD DETAIL FOR SMAW & GMAW

WELD LAYER	METHOD		ELECTRODE		RECOMMENDED	
	HORIZONTAL FIXED POSITION	▪ VERTICAL FIXED POSITION	CLASS	SIZE	AMPS	VOLTS
FIRST PASS	DOWNHILL ▾	BEAD	TABLE 1	ALL	90-100(GMAW) 100-170(SMAW)	18-20(GMAW) 26-28(SMAW)
HOT PASS (SEE NOTE 3)	DOWNHILL	BEAD	TABLE 1	1/8" OR 5/32"	120-160	24-28
FILLER PASSES	DOWNHILL ▾	BEAD	TABLE 1	ALL	140-180	24-28
COVER PASS	DOWNHILL ▾	BEAD	TABLE 1	ALL	140-180	24-28

▪ WASH PASSES SHALL NOT BE ACCEPTABLE IN VERTICAL FIXED POSITION.
▾ EXCEPTIONALLY WIDE DOWNHILL WASH PASSES SHALL NOT BE PERMITTED.

NOTES:

1. ALL CURRENT SHALL BE D.C. REVERSE POLARITY.
2. ELECTRODES:

	PG&E CODE NO.
3/32" E 6010 FLEETWELD 5P OR EQUAL	15-9252
1/8" E 6010 FLEETWELD 5P OR EQUAL	15-9026
5/32" E 6010 FLEETWELD 5P OR EQUAL	15-9027
3/16" E 6010 FLEETWELD 5P OR EQUAL	15-9028
1/8" E 7010 SHIELD ARC HYP OR EQUAL	15-9285
5/32" E 7010 SHIELD ARC HYP OR EQUAL	15-9286
3/16" E 7010 SHIELD ARC HYP OR EQUAL	15-9287
1/8" E 8010 SHIELD ARC 70+ OR EQUAL	15-9405
5/32" E 8010 SHIELD ARC 70+ OR EQUAL	15-9406
3/16" E 8010 SHIELD ARC 70+ OR EQUAL	15-9407

0.035" ER70S-6 LINCOLN L-56 OR EQUAL - AVAILABLE FROM GC HDQTRS. IN MANTECA

3. IF BACKWELDING, USE "HOT PASS" TECHNIQUES FOR (FIRST) BACKWELD PASS. USE CONVENTIONAL FILLER AND COVER TECHNIQUES, IF MULTIPLE PASSES ARE REQUIRED.
4. IN SOME OLDER PIPELINE INSTALLATIONS "PG&E SPECIFIED" PIPE WAS INSTALLED. THIS PIPE DOES NOT NECESSARILY COMPLY WITH API, ASTM OR ANY OTHER PIPELINE STANDARD. BEFORE WELDING ON "PG&E SPECIFIED" PIPE, CONSULT GAS SYSTEM DESIGN FOR THE PROPER WELDING PROCEDURES AND ELECTRODE(S) TO USE.

(200,2)0328436) .G24 04-11-88 DWH

APPROVED BY	REV	DATE	DESCRIPTION	DWN	CHKD	APVD
BFO	3	4-15-86	REV'D ROOT GAP & PAGE NO. FROM 13 TO 14; ADDED REQUIREMENTS FOR GMAW	DWH		BFO/CJT
RCB	2	2-25-86	REVISED PAGE NO. FROM 11 TO 13			BFO/PAL
RFD	1	8-3-84	ISSUE FOR USE-SUPERSEDED DWG. 084022; DEL'TD. NOTE 2 & RENUM'D; ADDED E8010 ELECTRODE TO NEW NOTE 2; ADDED NOTE 4 & TABLE 1			
PAL CJT						

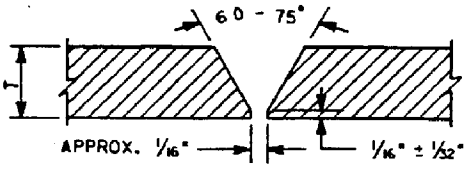
GM	
SUPV	[redacted]
DSGN	
DWN	[redacted]
CHKD	
OK	
DATE 8-3-84	SCALE NONE

PIPING - DATA SHEET
WELD DESIGN WITH CELLULOSE COATED AND WIRE ELECTRODES
GAS STANDARD
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

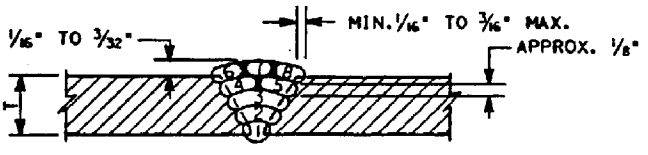
SUPERSEDES	084022
SUPERSEDED BY	
SHEET NO. 1 OF 1	SHEETS
DRAWING NUMBER	REV
284361	3

mk345

WELD DESIGN



STD. "V" BEVEL BUTT JOINT



SEQUENCE OF BEADS (NUMBER AND POSITION WILL VARY WITH CHANGE IN WALL THICKNESS, ETC)

WELD DETAIL

WELD LAYER	METHOD		ELECTRODE		RECOMMENDED	
	HORIZONTAL FIXED POSITION	* VERTICAL FIXED POSITION	CLASS	SIZE	AMPS	VOLTS
FIRST PASS	DOWNHILL	BEAD	NOTE 5	ALL	100-170	26-28
HOT PASS ◪	DOWNHILL	BEAD	NOTE 5	1/8" OR 5/32"	120-160	24-28
FILLER PASSES	UPHILL	BEAD	E 7016 OR E 7018	3/32" OR 1/8"	100-150	22-25
COVER PASS	UPHILL	BEAD	E 7016 OR E 7018	3/32" OR 1/8"	100-150	22-25

* WASH PASSES SHALL NOT BE ACCEPTABLE IN VERTICAL FIXED POSITION.

◪ IF BACKWELDING, USE "HOT PASS" TECHNIQUES FOR (FIRST) BACKWELD PASS. USE CONVENTIONAL FILLER AND COVER TECHNIQUES, IF MULTIPLE PASSES ARE REQUIRED.

NOTES:

1. ALL CURRENT SHALL BE D.C. REVERSE POLARITY.
2. ELECTRODES SPECIFIED ARE SUITABLE FOR ALL A.P.I. GRADES THROUGH X-60. FOR GRADE X-65 USE E 8016 OR E 8018 (3/32" OR 1/8" DIA.) ELECTRODE FOR FILLER AND COVER PASSES.
3. HANDLING INSTRUCTIONS AND WELD TECHNIQUE IN SECTION 2.6 MUST BE FOLLOWED.
4. LOW HYDROGEN ELECTRODE IS RECOMMENDED FOR HIGH YIELD, HEAVY WALL PIPE FOR STATION PIPING, RIVER CROSSINGS OR OTHER LOCATIONS WHERE VIBRATION OR EXTERNAL LOADING MAY OCCUR. IT SHOULD ALSO BE USED WHEN THE PREHEAT TEMPERATURE CANNOT BE MAINTAINED (REFER TO PARAGRAPH 2.8). IT PRODUCES A DUCTILE HIGH STRENGTH WELD WHICH GIVES SUPERIOR NOTCH STRENGTH. HOWEVER THE LOW HYDROGEN ELECTRODE (E-7016 OR E-7018) IS MORE TIME CONSUMING THAN THE CONVENTIONAL CELLULOSE ELECTRODE (E-6010, E-7010 OR E-8010). CONTACT THE GAS SYSTEM DESIGN DEPARTMENT IF MORE INFORMATION IS REQUIRED.
5. FOR FIRST PASS AND HOT PASS, USE ELECTRODES AS SHOWN ON DWG. 284361.
6. LOW-HYDROGEN ELECTRODES: 1/8" E 7018 (ALT: E 7016) HOBART, AIRCO, ALLOY RODS, OR LINCOLN USE CODE 15-9194.

284363-00- 1

[200,2103284363 .G24 04-11-86 DWH

APPROVED BY								
BFO		3	4-15-88	REVISED NOTES 2 AND 4; REVISED PAGE NO. FROM 14 TO 15	DWH		BFO/CJT
RCB		2	2-25-86	REV'D ELECTRODE SIZE FOR FILLER & COVER PASS & NOTE 6; REV'D PG. NO. FROM 12 TO 14	RDM	RAB	BFO/CJT
RFD		1	8-9-84	SUPERSEDES DWG. 086462			BFO/PAL/CJT
PAL	CJT	REV	DATE	DESCRIPTION	DWN	CHKD	APVD

GM
SUPV [redacted]
DSGN
DWN [redacted]
CHKD
OK
DATE 8-9-84
SCALE NONE

PIPING - DATA SHEET

WELD DESIGN WITH LOW-HYDROGEN ELECTRODES

GAS STANDARD

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

SUPERSEDES 086462
SUPERSEDED BY
SHEET NO. 1 OF 1 SHEETS
DRAWING NUMBER 284363
REV 3
MICROFILM

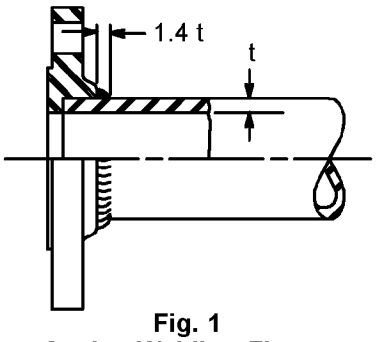


Fig. 1
Socket Welding Flange

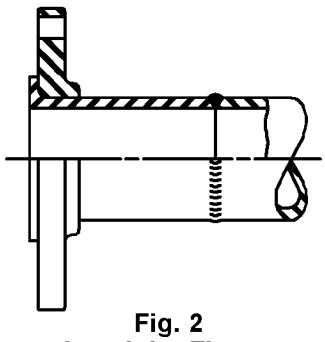


Fig. 2
Lap Joint Flange

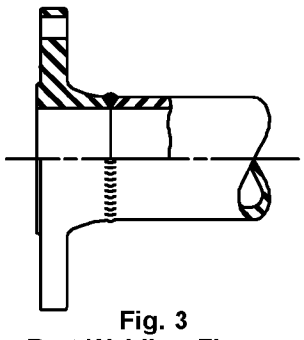
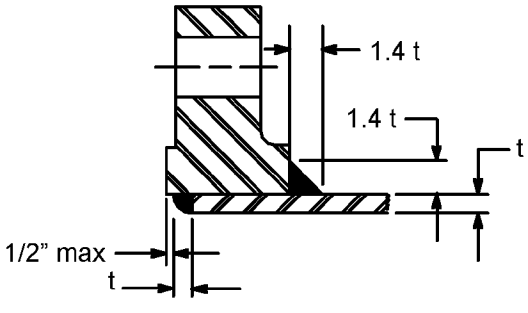
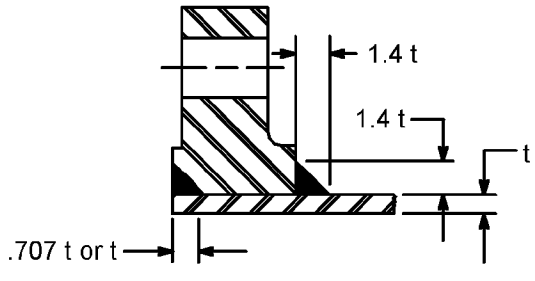


Fig. 3
Butt Welding Flange



Front and Back Weld



Face and Back Weld

Fig. 4
Slip on Flanges

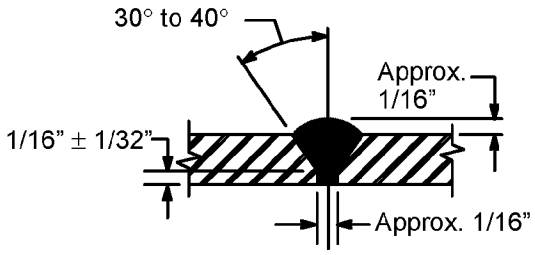


Fig. 5
Butt Weld Joint

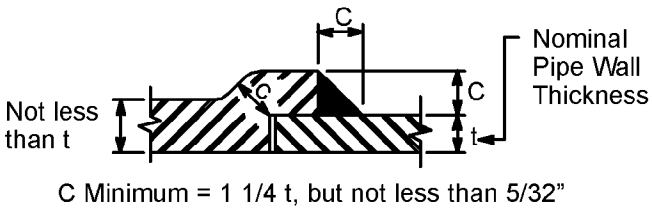


Fig. 6
Socket Weld Joint

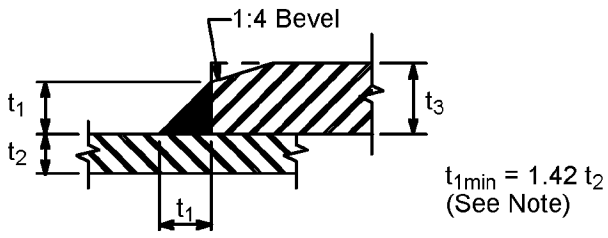


Fig. 7
Weld Sleeve Attachments
for 16" O.D. and Smaller Pipe

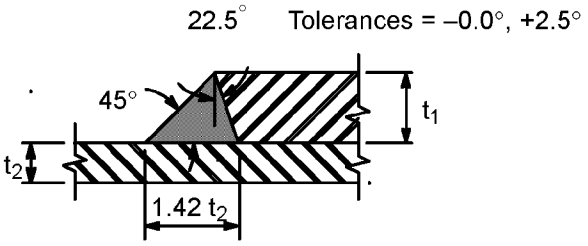


Fig. 8
Welding Sleeve Attachments for any Pipe Diameter.
(Must be used for 18" O.D. and Larger Pipe)

Note: refer to Gas. Std. A-60 for weld details when $t_{1\ min} \neq 1.42t_2$

REV.	DESCRIPTION	APPROVED BY	DATE
10	Redrawn, added figure numbers; revised Fig. 7, added Fig. 8	[redacted]	10-28-92

PG&E

ATTACHMENT USING BUTT OR FILLET WELDS FOR ARC WELDING NATURAL GAS PIPELINES

GAS TRANSMISSION

DOCUMENT NUMBER – PAGE

283263 1

Converted to Interleaf

W_1 (min.) = 3/8 B but not less than 1/4”
W_2 (min.) = 1/2 M but not less than 1/4”
or t which ever is smaller
N = 1/16 (Min.), 1/8” (max.)

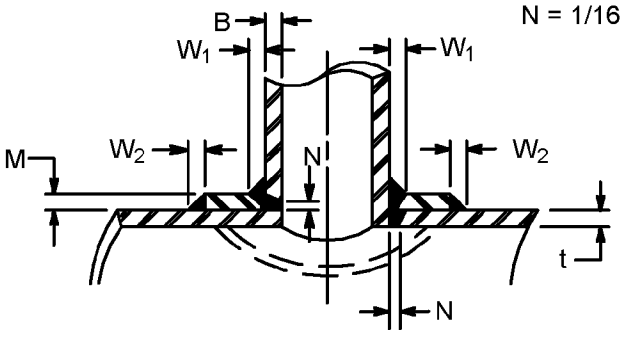


Fig. 9
Pad Type Reinforcement

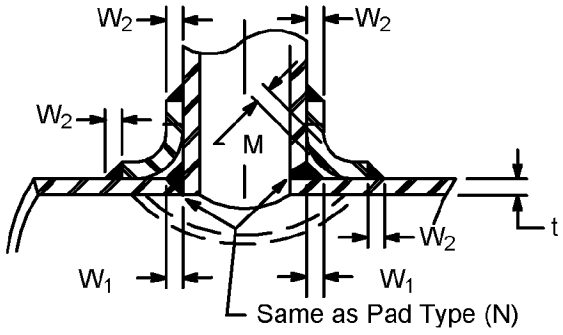
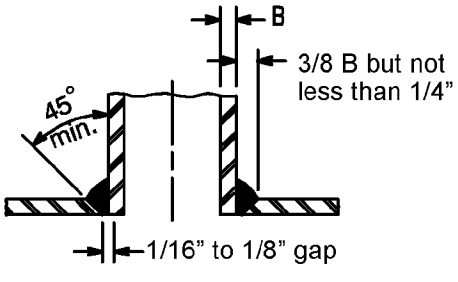
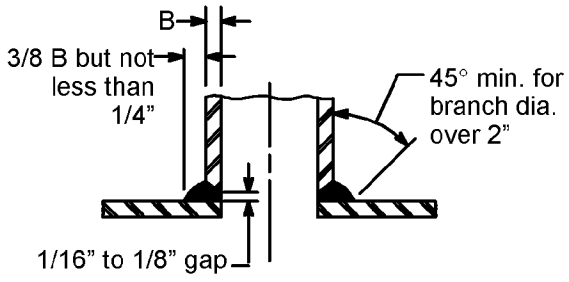


Fig. 10
Saddle Type Reinforcement



Branch Cut into Header



Branch Abutting Header

Fig. 11
Welding of Branch Connections Joint Design

REV.	DESCRIPTION	APPROVED BY	DATE
1	New page; added figure numbers	[redacted]	10-28-92

PG&E

ATTACHMENT USING BUTT OR FILLET WELDS FOR ARC WELDING NATURAL GAS PIPELINES

GAS TRANSMISSION

DOCUMENT NUMBER – PAGE
283263 2

Converted to Interleaf