1 0 SCOPE

1 1 The intent of this standard is to establish the welding procedure, the welder qualification, and the tests and inspection and procedures for welding all API 5L and 5LX grades of pipe material up to and including X60 on all natural gas lines operating at stress levels of 20% or more of the specified minimum yield strength to comply with CPUC G O 112C §192 241

1 2 Definitions pertaining to welding in this standard conform to the standard definitions contained in API Standard 1104, latest edition

1 3 All procedures covered in this standard have been established and qualified in accordance with API Standard 1104, latest edition

1 4 Any deviations from this welding standard shall be governed by the "Essential Variables" of API Standard 1104, latest edition, and shall be subject to approval by the Gas System Design Department

2 0 WELDING PROCEDURE

2 1 Process

2 1 1 All butt welds in pipe shall be made by the shielded metal arc welding process Piping in sizes 2 and under may be oxy-acetylene welded in accordance with procedure D-20

2 1 2 Welding may be performed by semi-automatic or automatic processes providing they are in compliance with a qualified and approved procedure

2 2 METHOD

Shielded metal arc welding of high pressure piping shall be performed either by the downhill or uphill methods in accordance with Drawing 084022

2 3 Materials and Equipment

2 3 1 Welding electrodes shall conform to ASTM Specification A-233-58T Classification E-6010 for welding all

FOR FIELD WELDING NATURAL GAS PIPELINES DESIGNED TO OPERATE AT 20% OR MORE OF SMYS

8	3 72	REVISED FOR COMPUTER LISTING, AND PARAGRAPH 1 1		7	10 71	REVISED SH 14, ADDED SH 40	
C	D	D	A	C	D	D	A

APPROVED

BY		PIPING – DATA SHEET	SUPERSEDES
DSGN		WELDER QUALIFICATION & CONSTRUCTION STANDARD	SUPERSEDED BY
DR.		GAS STANDARD	SHEET NO 1 OF 40 SHEETS
CH.		PACIFIC GAS AND ELECTRIC COMPANY	W M 084508 C 8
OK		SAN FRANCISCO CAL.	
DATE 2 10-71	SCALE NONE		

2 0 WELDING PROCEDURE (Continued)

2 3 Materials and Equipment (Continued)

2 3 1 (Continued)
API grades through X46 and E-7010 (See Drawing 084022) for all above X46 up to and including X60

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

2 4 Weld Preparation

2 4 1 Prior to welding all dirt paint, rust scale, grease, or other substance detrimental to welding shall be removed from the beveled ends of the pipe to be welded In cleaning the beveled ends prior to welding power driven grinders with abrasive fibre discs shall be used and all paint shall be removed back from the beveled end for a distance of two inches Grind all flame cut surfaces before welding

2 4 2 Before the lengths of pipe are welded together all loose rust debris and dirt shall be removed from the inside of the pipe by swabbing The lineup foreman shall visually inspect the inside of each pipe section before the pipe is aligned to insure compliance with this requirement

2 4 3 For pipe of the same nominal wall thickness the maximum offset or misalignment of the abutting pipe ends shall not exceed 1/16 inch If the pipe ends are damaged or dented beyond these acceptable limits they shall be cut off and rebeveled except minimum straightening of dented ends is permissible on pipe below grades X52 All hammers used for this purpose shall be faced with bronze or brass and due care shall be exercised to avoid abrasions

2 4 4 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

SHEET 2 OF 23 SHEETS	DRAWING NUMBER	CHANGE NOS
P G and E. CO.	084508	

2 0 WELDING PROCEDURE (Continued)

2 4 Weld Preparation (Continued)

2 4 5 A lineup clamp shall be used on pipe sizes 12' and greater Lineup clamp shall be left in place until first pass or stringer bead is complete

2 4 6 Adequate working clearance shall be provided around the pipe at all joints to be welded

2 4 7 Where pipe is of the longitudinal-seam-weld type, the pipe welds shall be staggered within the top quadrant at least 3' apart where practicable

2 4 8 Striking an arc on the pipe will not be permitted except in the welding groove

2 5 Preheating

2 5 1 All welding on pipe having a wall thickness greater than 0 500 inch shall be preheated to between 200° F and 400° F prior to and during welding

2 5 2 All grades shall be preheated to 200° F - 400° F when the pipe temperature is less than 50° F

2 5 3 Preheating shall be done with an approved torch system or with electric equipment which will provide uniform heating

2 5 4 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 5 Preheat temperatures shall be checked with temperature-sensitive crayons, such as 'Tempilstik' or by other approved monitoring methods

2 5 6 If a weld requires preheating the same temperature requirements shall be maintained for each succeeding pass

2 5 7 When steel materials with different preheat temperatures are being preheated for welding, the higher temperature must be used

0 WELDING PROCEDURE (Continued)

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+1/4Mn) exceeds 0 65 percent

2 6 1 2 When the wall thickness of the pipe being welded is 0 750 inch or greater unless cleared by G S D D and is mandatory for all thickness 1-1/4 or greater

2 6 1 3 When couplings weldolets or socket-weld-type fittings larger than two-inch pipe size are welded to a header with a wall thickness 0 750 inch or greater

2 6 2 Stress-Relieving Temperature

2 6 2 1 Heating to stress-relieving temperature range shall be done uniformly at a rate not to exceed 600° F per hour Above 600° F the rate of heating shall not exceed 400° F per hour

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 1/2 hour

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

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 greater than the width of the weld reinforcement whichever is greater

2 0 WELDING PROCEDURE (Continued)

2 6 Stress-Relieving (Continued)

2 6 3 Equipment for Local Stress-Relieving

2 6 3 1 Stress-relieving may be accomplished by electric induction, electric resistance fuel-fired ring burners, exothermic chemical reactions, or other suitable means of heating, provided that a uniform temperature is obtained during the stress-relieving

2 6 3 2 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

2 7 Position Welding

2 7 1 Welding Procedure

All position welds shall be made with the parts to be joined secured against movement and with adequate clearance around the joint to allow the welder or welders space in which to work

2 7 2 Filler and Finish Beads

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 by more than 1/16 inch After the root bead has been completed it is mandatory to add the second bead immediately, after which the specified number of beads may be made by finish welders

Two beads shall not 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 The completed weld shall be thoroughly brushed and cleaned

2 7 3 Pipe 16' and Over

On pipe 16 and over, the first or stringer pass should

2 0 WELDING PROCEDURE (Continued)

2 7 Position Welding (Continued)

2 7 3 Pipe 16 and Over (Continued)

be completed by two welders working in opposite quadrants of the pipe When only one welder is available for minor maintenance work on pipe 16 and larger the welder shall complete the stringer in one quadrant and then move to the opposite quadrant

2 8 Roll Welding

2 8 1 Maintaining Alignment

At the option of the Company 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

2 8 2 Filler and Finish Beads

The number of filler and finish 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 by more than 1/16 inch

The face of the completed weld should be approximately 1/8 inch wider than the width of the original groove As the welding progresses the pipe shall be rolled to maintain welding at or near the top of the pipe The completed weld shall be thoroughly brushed and cleaned

2 8 3 The second or hot pass shall be made immediately following the first or stringer pass and before the weld metal cools below 100° F Successive passes shall not be started at the same point

2 9 Vertical 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 passes deposited as beads in an

2 0 WELDING PROCEDURE (Continued)

2 9 Vertical Welds (Continued)

approximately horizontal plane The cover passes may be deposited as beads or by a laced technique

2 10 Fillet Welds

2 10 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

2 10 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

2 10 3 Fillet welds attaching supports and other non-pressure attachments to pressure piping are limited to pipe under API 51X Gd x 46 specification and operating under 50% of S M Y S and shall not exceed 3/8 x 2' long weld side

2 11 Treatment of Underside of Weld

2 11 1 Back welding the root bead shall be required on all welds on piping and fittings of different wall thickness that are accessible for inside welding The root of the weld shall be ground to sound metal on the inside of the pipe and two passes shall be deposited Inside weld passes shall be made by the 'downhill method of welding using E-6010 electrodes Where not accessible grinding is required as per Drawing 084033

2 12 Weld Identification

For quality control during construction each finished weld shall be clearly marked to identify the portion made by each welder Die Stamping will not be permitted

3 0 MULTIPLE QUALIFICATION (Initial Qualification)

3 1 The procedures to be followed by arc welders who will be welding on pipelines that are designated to operate at 20% or more of the specified minimum yield strength shall conform to API Standard 1104, latest edition

3 0 MULTIPLE QUALIFICATION (Continued)

3 1 1 Pipe - 12-3/4 O D X 250 wall or greater any grade

3 1 1 1 Butt Weld - The welder shall make a butt weld in the fixed position with the axis of the pipe either in the horizontal plane or inclined from the horizontal plane at an angle not exceeding 45°

3 1 1 2 Branch Connection - This test shall consist of of the welder laying out cutting, fitting and welding a full size branch on pipe connection The weld shall be made with the run pipe axis in the horizontal position and the branch pipe axis extending vertically downward from the run

3 2 Scope of Multiple Qualification - A welder who has successfully completed the above qualification test using 12-3/4' O D pipe shall be qualified to weld in all positions on all wall thicknesses joint designs including fillet welds and fittings on all pipe diameters and all grades of pipe

3 3 Essential Variables for Multiple Qualifications

3 3 1 A change from one welding process to any other welding process or combination of welding processes

3 3 2 A change in the direction of welding from vertical up to vertical down or vice versa

3 3 3 A change in filler metal from one classification group to another classification group as shown in table below

FILLER METAL CLASSIFICATION GROUPS

Group	ASTM SPEC	AWS SPEC	ELECTRODE
I	A223-64	A5 1 - 64	EXX 10
	A316-64	A5 5 - 64	EXX 11
II	A223-64	A5 1 - 64	EXX 15
	A316-64	A5 5 - 64	EXX 16
			EXX 18

3 0 MULTIPLE QUALIFICATION (Continued)

3 4 Requalification of Arc Welders

3 4 1 Welders shall be requalified at intervals not exceeding six (6) months Requalification shall consist of a radiographic examination of a production butt weld

3 4 2 A requalification test, by destructive methods and in accordance with the Multiple Qualification Test, may also be required if there is reason to question the welder's ability or if the welder has not engaged in Arc Welding for more than three (3) months

3 4 3 Annually, all welders who work on compressor station piping must pass a butt weld test by destructive methods, in accordance with 3 1 1 1 and with the process specified for compressor station piping in 3 3

3 5 Test Specimens

3 5 1 Test specimens shall be prepared as shown on Drawings #283709 and #084024

4 0 Testing of Welded Joints - Butt Welds (Destructive Test)

4 1 Preparation

The specimens shall be cut from the joint at the locations shown in Drawing #084019 The minimum number of specimens and the tests to which they are to be subjected are given in Drawing #084019 The specimens shall be prepared as shown in Drawing #283709 For pipe under 2-3/8 inches in diameter, two test welds shall be made to obtain the required number of test specimens The specimens shall be air cooled to ambient temperature before being tested For pipe 1-5/16 inches in diameter and smaller one full section specimen may be substituted for the four reduced section nick break and root bend specimens The full section specimen shall be tested in accordance with Par 4 2 2 and it shall meet the requirements of Par 4 2 3

4 0 TESTING OF WELDED JOINTS - BUTT WELDS (Continued)

4 2 Tensile Strength

4 2 1 Preparation

The specimens (Dwg 283709) shall be approximately 9 inches long and 1 inch wide They may be machine-cut or oxygen-cut and no other preparation is needed unless the sides are notched or are not parallel If necessary the specimens shall be machined so that the sides are smooth and parallel

4 2 2 Method

Tensile test specimens shall be ruptured under tensile load The tensile strength shall be computed by dividing the maximum load at failure by the least cross-sectional area of the specimen as measured before load is applied

4 2 3 Requirements

The tensile strength of the weld including the fusion zone of each specimen shall be equal to or greater than the specified minimum tensile strength of the pipe material If the specimen breaks outside the weld or fusion zone and the observed strength is not less than 95 percent of the specified minimum tensile strength of the pipe material, then the test shall be accepted as meeting the requirements

If any of the specimens break outside the weld or fusion zone and the observed strength is less than 95 percent of the specified minimum tensile strength of the pipe material, then these specimens shall be put aside and an equal number of additional specimens shall be cut from the weld and subjected to the tensile test If any of the additional specimens break outside the weld or fusion zone and the observed strength is also below the limit indicated above then the weld shall be set aside and a new test weld shall be made

4 0 TESTING OF WELDED JOINTS - BUTT WELDS (Continued)

4 3 Nick-Break Test

4 3 1 Preparation

The specimens (Dwg 283709) shall be approximately 9 inches long and 1 inch wide and they may be machine-cut or oxygen-cut They shall be notched with a hack-saw on each side at the center of the weld and each notch shall be approximately 1/8 inch deep

Nick-break specimens prepared in this manner from welds made with certain automatic and semi-automatic processes may fail through the pipe instead of the weld When previous testing experience indicates failures through the pipe are to be expected, the external reinforcement may be notched to a depth not to exceed 1/16 inch measured from the original weld surface

4 3 2 Method

The specimens shall be broken by pulling in a tensile machine, by supporting the ends and striking the center or by supporting one end and striking the other end with a hammer The exposed area of the fracture shall be at least 3/4 inch wide

4 3 3 Requirements

The exposed surfaces of each specimen shall show complete penetration and fusion and (a) there shall be no more than six gas pockets per square inch of surface area with the greatest dimension not to exceed 1/16 inch, (b) slag inclusions shall not be more than 1/32 inch in depth nor 1/8 inch or one-half the nominal wall thickness in length whichever is shorter and there shall be at least 1/2 inch of sound weld metal between adjacent inclusions The dimensions should be measured as shown in Drawing 083976

4 4 Root and Face Bend Test

4 4 1 Preparation

The specimens (Dwg #283709) shall be at least 9 inches long by 1 inch wide and the long edges shall be rounded

4 0 TESTING OF WELDED JOINTS - BUTT WELDS (Continued)

4 4 Root and Face Bend Test (Continued)

4 4 1 Preparation (Continued)

They may be machine-cut or oxygen-cut The cover and root bead reinforcement shall be removed flush with the surface of the specimen These surfaces shall be smooth and any scratches which exist shall be light and transverse to the weld

4 4 2 Method

The specimens shall be bent in a guided bend test jig similar to that shown in Dwg #084109 Each specimen shall be placed on the die with the weld at mid-span Face bend specimens shall be placed with the face of the weld directed toward the gap and root bend specimens shall be placed with the root of the weld directed toward the gap The plunger shall be forced into the gap until the curvature of the specimen is approximately U-shaped

4 4 3 Requirements

The bend test shall be considered acceptable if no crack or other defect exceeding 1/8 inch or 1/2 the nominal wall thickness whichever is smaller in any direction is present in the weld or between the weld and the fusion zone after bending Cracks which originate along the edges of the specimen during testing and which are less than 1/4 inch measured in any direction shall not be considered unless obvious defects are observed Each specimen subjected to the bend test shall meet these requirements

4 5 Side Bend Test

4 5 1 Preparation

The specimens (Dwg #283709) shall be at least 9 inches long by 1/2 inch wide and the long edges shall be rounded They shall be machine-cut or they may be oxygen-cut to approximately a 3/4 inch width and then machined or ground to the 1/2 inch width The sides shall be smooth and parallel The cover and root bead reinforcements shall be removed flush with the surfaces of the specimen

4 0 TESTING OF WELDED JOINTS - BUTT WELDS (Continute)

4 5 Side Bend Test (Continued)

4 5 2 Method

The specimens shall be bent in a guided bend test jig similar to that shown in Dwg #084109 Each specimen shall be placed on the die with the weld at mid-span and with the face of the weld at 90 degrees to the gap The plunger shall be forced into the gap until the curvature of the specimen is approximately U-shaped

4 5 3 Requirements

Each specimen shall meet the Face and Root Bend Test Requirements Par 4 4 3

5 0 TESTING OF WELDED JOINTS - FILLET WELDS & BRANCH WELDS

5 1 Preparation

Test specimens shall be cut from the joint at the locations shown in Dwg #084029 The minimum number of specimens and the test to which they are to be subjected are given in Dwg #084029

5 2 Method

The specimens shall be broken by supporting both ends of the specimen and striking the center or by supporting one end and striking the other The specimens shall be bent so that the root of the weld is subjected to the greater strain

5 3 Records

The pipeline welder qualification or requalification test Form No 7539 data for weld procedure qualifications shall be filled out for each welder and retained in either the Division Office or the Manager of Gas Construction files for two years

6 0 INSPECTION AND TESTING OF PRODUCTION WELDS - NON DESTRUCTIVE TESTING

6 1 Weld quality shall be checked by non destructive examination The following percentages of each day s field butt welds operating at 20% or more of S M Y S must be examined non destructively over their entire circumference

6 1 1 Class 1 and 2 locations, 20 percent

6 1 2 Class 3 and 4 locations at crossings of major navigable rivers, 100 percent if practical, but not less than 90 percent

6 1 3 Welds which contain repaired areas, within railroad or public highway rights of way, including tunnels, bridges and overhead road crossings, and at pipeline tie-ins, 100 percent

Visual examination in accordance with Section 6 3 2 may be substituted under the conditions outlined in order to fulfill the examination requirements of this section

6 2 Records

6 2 1 Inspection reports on pipelines designed to operate at stresses over 20 percent of S M Y S , required under 6 1, shall be recorded on Form Number 75-307 attached, and retained for the life of the pipeline facility

6 2 2 When non-destructive testing is required under 6 1 1, 6 1 2, or 6 1 3 above, the Company must retain, for the life of the pipeline, a record summarizing the results of Form 75-307 using Form Number 77G-18 attached

6 2 3 Divisions are requested to arrange with the Gas Construction Department to handle all radiographic testing

6 3 Visual Inspection

6 3 1 Welds that are to be non-destructively examined under Paragraphs 6 1 1 6 1 2, and 6 1 3 may be examined visually by a qualified welding inspector under the following conditions

a The pipe has a nominal diameter of less than 6 inches at any stress level, or

b The pipeline operates at a pressure of under 40 percent of S M Y S and the welds are so limited that non-destructive testing is impractical

6 3 2 Visual inspection shall consist of the following elements

a The welding is performed in accordance with the welding procedure, and

b The weld is acceptable as per Paragraph 6 of this Standard

c Observe that there has been careful disposition of weld metal Particular attention shall be directed to the first two passes the cleaning between passes, and the finished appearance of the weld

d The dimension of the finished weld shall comply with Dwg #084022 The weld must be free of cracks, inadequate penetration burn through and other defects and it must present a neat workmanlike appearance Undercutting adjacent to the final bead on the outside of the pipe shall not exceed 1/32 inch in depth or 12-1/2 percent of the pipe wall thickness whichever is smaller, and there shall not be more than 2 of undercutting in any continuous 12 inch length of weld

7 0 STANDARDS OF ACCEPTABILITY - NON-DESTRUCTIVE TESTING

7 1 Introduction

These standards of acceptability are applicable to the determination of the size and type of defects located by radiography and other non-destructive test methods They may also be applied to visual inspection They shall not be used to determine the quality of welds which are subjected to destructive testing Irregularities which are detected by radiography or other non-destructive tests shall be reported

Radiographic procedure and acceptability of radiography shall be as set forth in Gas Standards D-33

7 2 Right of Rejection

Since non-destructive test methods give two dimensional results only, the Company may reject welds which appear to meet these standards of acceptability if the depth of the defect may be detrimental to the strength of the weld

7 3 Inadequate Penetration and Incomplete Fusion

Essentially inadequate penetration is defined as the incomplete filling of the weld root with weld metal Incomplete fusion is defined as lack of bond between beads or between weld metal and the base metal Inadequate penetration and incomplete fusion are separate and distinct conditions which occur in different forms and the acceptable limits of these various forms are set forth by the paragraphs which follow

7 3 1 Inadequate Penetration of Weld Root

Inadequate penetration without high-low present is defined as the incomplete filling of the weld root A schenatic representation of this condition is given in Dwg #085177(A) Any individual condition due to this type of inadequate penetration shall not exceed 1 inch The total length of such condition in any continuous 12 inch length of weld shall not exceed 1 inch If the weld is less than 12 inches long then the total length of such condition shall not exceed 8 percent of the weld length

7 3 2 Inadequate Penetration Due to High-Low

High-low is defined as a condition where the pipe and/or fitting surfaces are misaligned This situation is represented schematically by Dwg #085177(B)(C) High-low is not objectionable provided that the root of adjacent pipe and/or fitting joints is completely tied-in (bonded) by weld metal When one edge of the root is exposed (or unbonded) the length of this condition shall not exceed 2 inches at individual locations or 3 inches in any continuous 12 inch length of weld

7 3 3 Internal Concavity

Internal concavity as used in this standard shall mean a bead which is properly fused to and completely penetrates the pipe wall thickness along both sides of the bevel but the center of the bead is somewhat below the inside surface of the pipe wall The magnitude of concavity shall be defined as the perpendicular distance between and axial extension of the pipe wall surface and the lowest weld bead surface point Shown schematically in Dwg #085177 (D) The density of the radiographic image associated with internal concavity shall not exceed that of the adjacent base metal The length of the internal

concavity is not a factor for consideration when determining acceptability of this condition Internal concavity is associated with a continuously deposited weld bead and it differs from burn-through areas which are associated with intermittently deposited weld metal

7 3 4 Incomplete Fusion

Incomplete fusion at the root of the joint or at the top of the joint between the weld metal and the base metal (See Dwg #085177 (E)) shall not exceed 1 inch in length The total length of such conditions in any 12 inch length of weld metal shall not exceed 1 inch If the weld is less than 12 inches long then the total length of such conditions shall not exceed 8 percent of the weld length

7 3 5 Incomplete Fusion Due to Cold Lap

Incomplete fusion due to cold lap is a discontinuity between two adjacent weld beads or between a weld bead and the base metal For the purposes of this standard incomplete fusion due to cold lap is a subsurface discontinuity and thus it differs from incomplete fusion referred to in Par 7 3 4 Incomplete fusion due to cold lap is depicted schematically in Dwg #085177(F) Individual incomplete fusion due to cold lap discontinuities shall not exceed 2 inches in length The total length of incomplete fusion due to cold lap in any continuous 12 inch length of weld shall not exceed 2 inches

7 4 Burn-Through

A burn-through is that portion of the root bead where excessive penetration has caused the weld puddle to be blown into the pipe

7 4 1 For pipe 2-3/8 Inches O D and Larger

Any unrepaired burn-through shall not exceed 1/4 inch or the thickness of the pipe wall whichever is smaller in any dimension The sum of the maximum dimensions of separate unrepaired burn-through in any continuous 12 inch length of weld shall not exceed 1/2 inch Radiographs of repaired burn-throughs shall show that these have been properly repaired

7 4 2 For Pipe Less Than 2-3/8 Inches O D

No more than one unrepaired burn-through is acceptable and it shall not exceed 1/4 inch or the thickness of the pipe wall whichever is the smaller in any dimension Radiographs of repaired burn-throughs shall show that these have been properly repaired

7 5 Slag Inclusions

A slag inclusion is a non-metallic solid entrapped in weld metal or between the weld metal and the pipe metal Elongated slag inclusions are usually found at the fusion zone Isolated slag inclusions are irregularly shaped inclusions and may be located anywhere in the weld

7 5 1 Elongated Slag Inclusions (Wagon Tracks)

7 5 1 1 For Pipe 2-3/8 Inches O D and Larger

Any elongated slag inclusions shall not exceed 2 inches in length or 1/16 inch in width The total length of elongated slag inclusions in any continuous 12-inch length of weld shall not exceed 2 inches Parallel slag lines shall be considered as separate conditions if the width of either exceeds 1/32 inch

7 5 1 2 For Pipe Less Than 2-3/8 Inch O D

Individual elongated slag inclusions shall not exceed 1/16 inch in width or three times the nominal wall thickness in length Parallel slag lines shall be considered as separate conditions if the width of either one of them exceeds 1/32 inch

7 5 2 Isolated Slag Inclusions

7 5 2 1 For Pipe 2-3/8 Inch O D and Larger

The maximum width of any isolated slag inclusions shall not exceed 1/8 inch The total length of isolated slag inclusions in any continuous 12-inch length of the weld shall not exceed 1/2 inch nor shall there be more than four isolated slag inclusions of the maximum width of 1/8 inch in this length

7 5 2 2 For Pipe Less Than 2-3/8 Inches O D

The maximum width of any isolated slag inclusion shall not exceed 1/2 the nominal wall thickness and the total length of such inclusions shall not exceed twice the nominal wall thickness

7 6 Porosity or Gas Pockets

Porosity or gas pockets are voids occurring in the weld metal

7 6 1 Spherical Porosity

The maximum dimension of any individual spherical gas pocket shall not exceed 1/8 inch or 25 percent of the pipe wall thickness whichever is the lesser The maximum distribution of spherical porosity shall not exceed that shown in Dwgs #084025 and #084026

7 6 2 Cluster Porosity

Cluster porosity which occurs in the finish pass shall not exceed an area of 1/2 inch diameter with the maximum dimensions of any individual gas pocket within the cluster not to exceed 1/16 inch The total length of cluster porosity in any continuous 12 inch length of weld shall not exceed 1/2 inch Cluster porosity occurring in all other passes shall comply with Paragraph 7 6 1

7 6 3 Piping (Wormhole) Porosity

Piping (wormhole) porosity is an elongated discontinuity which results when the gas rises through the solidifying weld metal The maximum dimension of the radiographic image associated with wormhole porosity shall not exceed 1/8 inch or 25 percent of the pipe wall thickness whichever is the lesser The maximum distribution for wormhole porosity shall not exceed that shown in Dwg #084025 The orientation of this discontinuity will substantially affect the density of the radiographic image and when applying these limits, consideration shall be given to the provisions of Par 7 2

7 6 4 Hollow Bead

Hollow bead is elongated linear porosity occurring in the root pass The maximum length of this discontinuity shall not exceed 1/2 inch The total length of hollow bead in any continuous 12 inch length of weld metal shall not exceed 2 inches and individual adjacent discontinuity exceeding 1/4 inch in length shall be separated by at least 2 inches of sound weld metal

7 7 Cracks

Shallow crater cracks or star cracks which are located at the stopping point of weld beads and which are the result of weld metal contraction during solidification are not considered injurious defects unless their length exceeds 5/32 inch With the exception of these shallow crater cracks no weld containing cracks regardless of size or location shall be acceptable

7 8 Accumulation of Discontinuities

Excluding high-low condition any accumulation of discontinuities having a total length of more than 2 inches in a continuous weld length of 12 inches or more than 8 percent of a continuous weld length if the total weld length is less than 12 inches is unacceptable Any accumulation of discontinuities which total more than 8 percent of the weld length associated with an entire joint is unacceptable

7 9 Undercutting

Undercutting is the burning away of the side walls of the welding groove at the edge of a layer of weld metal or the reduction in the thickness of the pipe wall adjacent to the weld and where it is fused to the surface of the pipe

Undercutting adjacent to the cover bead on the outside of the pipe shall not be V shaped nor shall it exceed 1/32 inch or 12-1/2 percent of the pipe wall thickness whichever is smaller in depth nor shall it exceed 2 inches in length or 1/6 the length of the weld whichever is the smaller Undercutting adjacent to the root bead on the inside of the pipe shall not exceed 2 inches in length or 1/6 of the length of the weld whichever is smaller

7 10 Pipe Defects

Laminations split ends or other defects in the pipe shall be repaired or removed as directed by the Company

8 0 REPAIR OR REMOVAL OF DEFECTS

8 1 Authorization for Repairs

Defects except cracks in the root and filler beads may be repaired with prior Company authorization Defects except cracks in the cover pass may be repaired without prior Company authorization

8 2 Each weld that is repaired must have the defect removed down to clean metal and the segment to be repaired must be preheated After repair the segment of the weld that was repaired must be inspected as per 6 1 3 to ensure its acceptability If the repair is not acceptable the weld must be removed

9 0 LOW HYDROGEN ELECTRODE

The additional procedure and welder qualification tests using low hydrogen electrodes are included here for operators who may be required to use them

9 1 Welding Rod

9 1 1 Welding rod shall conform to A W S classification E6016 and/or E7016 electrode The diameter of these electrodes should not exceed 5/32

9 1 2 E7018 low hydrogen iron powder electrode may be substituted for conventional low hydrogen electrode

9 1 3 Low hydrogen electrodes must be stored and handled in a manner to prevent absorption of moisture

9 1 4 Proper storage facilities shall be provided for electrodes in moisture proof containers to prevent damage to the containers which could cause the seal to be broken Normally opened containers of low hydrogen electrodes will not be stored

9 1 4 1 Electrodes removed from sealed moisture proof containers may be stored in a suitable drying oven if available No other storage facility is acceptable

9 1 5 Electrodes shall be purchased and distributed to the welders in 10-pound hermetically sealed moisture proof containers

9 1 6 Electrodes left overnight or exposed to ambient conditions for less than 1 week without the proper protection shall not be used without first being re-processed in a drying oven at 500° F for 1 hour Longer exposure will require re-drying at 700° F for 1 hour If a suitable drying oven is not available electrodes shall be thrown away

9 1 7 Electrodes shall not be exposed to moisture by the welder

9 1 8 All welders qualified to use this type electrode will be thoroughly instructed in its storage and handling requirements

9 2 Welding Technique

9 2 1 The uphill method of depositing weld metal shall be used

9 2 2 Strike arc ahead of the starting point and bring the arc back to starting point (welding should then proceed over the point where the arc was struck)

9 2 3 The weld passes should be beaded rather than weaved with particular care not to whip the electrode

9 2 4 Clean each beading thoroughly (Low hydrogen electrode is not deep penetrating any slag or foreign matter may be entrapped and will not burn out when depositing subsequent beads)

9 2 5 Low Hydrogen Electrode Classification size and current required for fillet weld (See Dwg #084022)

9 3 Welder Qualification

9 3 1 Welder shall be qualified in accordance with Par 3 0 to weld on API-5L and 5LX grade pipe

9 3 2 Welder in addition to the standard test set forth in Par 3 0 shall qualify himself to use low hydrogen electrode for the types of welds normally encountered in our operation by completing test welds using the welding technique described in Par 9 2 above and outlined in Dwg #084119 of this Standard Procedure

The following test fillet welds with low hydrogen electrodes are required

9 3 2 1 Two test welds - 3/4 pipe branch outlet in 1-1/2 run with 154 wall API-5L Grd B pipe Weld made with the branch on the bottom of the run

9 3 2 2 One test weld - 12 sleeve on 12 run in the range of 219 to 375 wall API-5LX Grd pipe Weld made in the horizontal fixed position

9 3 2 3 Qualification under section 9 3 2 1 qualifies a welder to make branch outlets weld service tees and socket or sleeve welds in all positions on pipe up to 2-3/8 O D and wall thickness up to 188 in grades from API-5L Grd B to API-5LX Grd X52

9 3 2 4 Qualification under section 9 3 2 2 qualifies a welder to make sleeve welds on pipe up to API-5LX Grd X60

9 4 Tests required for work on materials and thicknesses exceeding 9 3 above will be established by Gas System Design Department

9 5 Testing of welded joints for low hydrogen fillet welds shall be in accordance with Paragraph 4 3