1. SCOPE

1.1 This standard specifies requirements for repair of steel pipelines.

1.2 The following criteria are established:

1.2.1 Maximum hoop stress permitted during welding.

1.2.2 Specifies allowable methods of repair for welded steel pipelines.

1.2.3 Work procedures and design requirements for allowable repair methods.

1.2.4 Welding procedure on pipelines under pressure.

1.2.5 Cathodic protection requirements for leak repairs.

1.3 It is not the intent of this standard to preclude the use of methods of repair other than welding, such as temporary emergency methods or mechanical clamps, when these other methods are more appropriate (such as anticipated early retirement of the main). However, any alternate action taken must be in compliance with G.O. 112-D.

2. MAXIMUM HOOP STRESS PERMITTED DURING WELDING

2.1 Prior to performing any welding on a pipeline under pressure, an evaluation must be made to determine if the operating pressure needs to be lowered so that the hoop stress will be at or below the level specified by this standard. Guidelines for determining the maximum operating pressure permitted during welding are provided in Paragraphs 2.2, 2.3, 2.4 and 2.5 of this standard. They are the maximum pressures, which are also shown on the Pipeline Survey Sheets. Where the condition of the pipe is found to be poor, or where other conditions exist which could cause problems while performing the welding, a lower operating pressure may be necessary. This lower pressure should be determined based on an evaluation of the observed condition of the pipe and good engineering judgement.

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.
		8	7-26-88	Rev'd. Para. 4.6-Limited Canning to 100 PSI					
WER	JLL	7	4-15-88	Revised as indicated		BEO/WJH/RFD/PCH			
RES	TOB	6	2-5-87	Added Paragraph 2.1 and Renumbered				PAL	CJT
EFS	JAF	5	4-30-85	Ch'd "D" to Nom. Outside Dia. per Suggestion			BEO/PAL/CJT		

GM		B/M	
SUPV.		DWG. LIST	
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PIPING - DATA SHEET
REPAIR OF PIPELINE DEFECTS

GAS STANDARDS

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

88797

61-4344 (REV. 1-76) PRINTED ON DIEPO NO. 1020 CLEARPRINT 11-80

MICROFILM

2.2 For seamless and double submerged arc welded pipe, the maximum pressure permitted during welding shall be determined using the formula given below or the MAOP, or a pressure which will produce a hoop stress of 50% of the specified minimum yield strength, whichever is lowest:

$$P = \frac{2S(t - 0.094 \text{ in.})(0.72)}{D}$$

P = Internal Pressure, psig
S = Specified Minimum Yield Strength, psi
t = Nominal Pipe Wall Thickness, inches
D = Outside Pipe Diameter, inches

For all other pipe, the maximum pressure permitted during welding shall be determined by the formula given above or the MAOP, or a pressure which will produce a hoop stress of 40% of the specified minimum yield strength, whichever is lowest.

2.3 The maximum hoop stress permitted during welding shall not exceed 20% of the specified minimum yield strength when:

2.3.1 Welding within 3" of the longitudinal seam, the circumferential, and any branch weld on any type of pipe except the longitudinal seam of double-submerged arc welded pipe.

2.3.2 Welding within 3" of any defect (gouges, corrosion, laminations, etc.) in the pipe which exceeds 1/3 of the nominal wall thickness in depth and/or 1/4 of the nominal pipe diameter in length. Any number of closely spaced adjacent defects shall be treated as one defect of a size and depth encompassing all the defects.

2.3.3 More than one weld repair is required in any length equal to five pipe diameters or five feet, whichever is less.

2.4 When preheating to temperatures less than 450°F, the maximum hoop stress permitted shall not exceed 50% of the specified minimum yield strength for seamless and double submerged arc welded pipe, or 40% of the specified minimum yield strength for all other types of pipe.

2.5 Preheating above 450°F or high temperature stress relieving is not permitted on pipelines under pressure. The yield point and fracture sensitivity of non-expanded high strength pipe are adversely affected when it is heated above 600°F unless it is heated and cooled under controlled conditions. The yield point of expanded pipe is permanently lowered by approximately 20% when it is heated above this temperature.

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3. METHODS OF REPAIR

3.1 Only those methods of repair recommended in this standard are approved as permanent repairs to welded steel mains. When a repair cannot be made in conformance with the conditions of this standard, the section of defective pipe shall be replaced with a good piece of pipe. The most appropriate method of repair permitted shall be selected from the proper "Welding Repair Selection Chart" (see charts I, II, and III attached) and the repair completed in conformance with the work procedures established in paragraphs 2, 4, 5, and 6.

4. WORK PROCEDURES AND DESIGN REQUIREMENTS

4.1 Grinding

When grinding to eliminate a defect, care must be used to remove the entire defect. Such grinding shall be smoothly contoured to the pipe to eliminate all possible points of stress concentration.

4.2 Grinding and Fill Welding

When grinding and fill welding, the repair area must be ground clean. The fill weld metal shall penetrate the base material. The surface of the finished repair weld shall be ground smooth to the contour of the pipe on all lines operating over 100 psi.

4.3 Patching

Patches shall be designed, installed and tested in accordance with Gas Standard A-64.

4.4 Sleeving

Sleeve design and testing shall be in accordance with Gas Standard A-60 or A-61.

4.5 Mueller Save-A-Valve Nipple

The Mueller Save-A-Valve nipple may be used to repair an individual corrosion pit (either leaking or non-leaking) where the diameter of the pit at the surface of the pipe is less than the inside diameter of the nipple. The weld shall be visually inspected. Refer to Gas Standard A-62 for installation procedure on high pressure mains. See the Welding Repair Selection Charts for pressure-stress level limitations when using the Mueller Save-A-Valve.

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* 4.6 Canning

Gas main repair cans may be used for repairs on pipelines with a design pressure which produces a hoop stress of less than 20% SMYS and not exceeding 100 psi. Can design and testing shall be in accordance with Gas Standard A-63.

4.7 Replace Segment of Pipe

Take the segment out of service. Remove the damaged portion of pipe by cutting out cylindrical piece of pipe. Replace it with pipe of equal or greater design strength and equal or greater wall thickness. Testing shall be performed as set forth in Gas Standards A-34 and D-33.

4.8 Dents (Pipe Distortion)

4.8.1 Distortion or denting may be defined as a depression which produces a gross disturbance in the curvature of the pipe wall (as opposed to a scratch or gouge which reduces the pipe wall thickness). The depth of a dent shall be measured as the gap between the lowest point of the dent and prolongation of the original contour of the pipe in any direction.

4.8.2 All dents which affect the curvature of the pipe at the longitudinal or any circumferential weld shall be removed on mains operating at greater than 100 psi. Dents at welds in mains operating below 100 psi shall be treated the same as a dent which does not affect a weld.

4.8.3 Per cent distortion shall be defined as the ratio of the depth of the dent to the actual diameter of the pipe times 100. Distortion exceeding the limitations in Chart I, II, and III shall be removed.

5. WELDING PROCEDURE ON PIPELINES UNDER PRESSURE

5.1 Arc welding and preheat on pipe while under pressure shall be as specified in D-22. Arc welding is preferred for all repairs. For small lower pressure lines where arc welding is not convenient or the equipment is not readily available, oxyacetylene welding may be used wherever it is allowed under Gas Standard D-20.

5.1.1 When the surface temperature of the pipe is less than 50° the pipeline flow should be made static and the pipe preheated and welded as set forth in D-22.

* Paragraph Revised

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5.1.2 When the surface temperature of the pipe is less than 50°F, and the pipeline flow cannot be made static, all welding thereon shall be made using low hydrogen electrode in accordance with the procedures set forth in D-22.

5.1.3 Before welding, proper precautions shall be taken to make sure that there are no liquids in the segment of the pipeline to be welded. Install drains per Gas Standards A-32 or A-32.1 and check existing drains for liquids.

5.2 All pipe having a wall thickness greater than .500" shall be preheated before and during welding.

5.3 Any welding on X-60 or X-65 pipe which is in service shall be done using an approved welding procedure. All low hydrogen electrodes or Gas Metal Arc Welding shall be used if the line flow cannot be made static. If line flow is made static and welding is to be done using cellulose electrodes, the pipe at the weld location must be preheated in accordance with Gas Standard D-22.

5.4 INSTRUCTIONS FOR FIELD APPLICATION

It is recommended that each division tabulate the maximum operating pressure permitted during the various welding operations for each transmission line or principal distribution main within the division. The tabulations should include a listing of extent of defect, permissible methods of repair and actual dimensions or other limitations on the method of repair. The tabulation should be designed to facilitate routine application of this standard under emergency field conditions by repair personnel.

6. CATHODIC PROTECTION REQUIREMENTS FOR LEAK REPAIRS

Install one 9-lb. magnesium anode or one 5-lb. zinc anode on each corrosion leak repair unless adequate pipe to soil potential is measured at the leak location.

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