

PACIFIC GAS AND ELECTRIC COMPANY
GAS DEPARTMENT STANDARDWELDING AND REPAIRS MADE BY WELDING ON MAINS
UNDER PRESSURE1. Scope

- 1.1 This standard applies to any welding operation, including preheating and stress relieving, performed on gas mains or pipelines under gas pressure.
- 1.2 The following criteria are established:
- 1.21 Maximum pressure stresses permitted during welding.
- 1.22 Approved types of welding repairs.
- 1.23 Limitations and restrictions on permissible methods of repair for welded steel mains.
- 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).

2. Maximum Hoop Stress Permitted During Welding

- 2.1 The maximum hoop stress permitted during welding shall not exceed 50% of the specified minimum yield strength of the pipe for seamless and double submerged arc welded pipe.
- The maximum hoop stress permitted during welding shall not exceed 40% of the specified minimum yield strength of the pipe for all other types of pipe.
- 2.2 Under the following conditions, the maximum hoop stress permitted during welding shall not exceed 20% of the specified minimum yield strength.

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- 2.21 When welding within 3" of the longitudinal seam weld on any type of pipe except double-submerged or single-submerged arc welded pipe.
- 2.22 When any defect (gouges, etc., corrosion, laminations) in the pipe 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.
- 2.23 When more than one weld repair is required in any length equivalent to five pipe diameters or five feet, whichever is the lesser.
- 2.3 The maximum hoop stress permitted during preheating to temperatures less than 450° F shall not exceed 50% of the specified minimum yield strength for seamless and double submerged arc welded pipe. The maximum hoop stress permitted during preheating shall not exceed 40% of the specified minimum yield strength for all other pipe materials.
- 2.4 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.
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 1, 2, and 3 attached) and the repair completed in conformance with the work procedures established in Paragraphs 2 and 4. Testing of replaced sections of pipe shall be performed as set forth in SP 1604.

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 and the fill weld metal shall penetrate the base material. The surface of the finish repair weld shall be ground smooth to the contour of the pipe on all lines operating over 100 psi.

4.3 Patching

Patch material shall be at least as thick as the pipe wall. Patches shall be designed with a thickness and grade of material capable of withstanding the design pressure of the main at a stress level in the patch of not more than 50% of the specified minimum yield strength of the patch material. Patches shall have well rounded corners.

4.4 Sleeving

4.41 The maximum stress level of the sleeve shall not exceed 50% of the specified minimum yield strength of the sleeve material at the design pressure of the main. Sleeve design shall be in accordance with Gas Standard CS 100.

4.42 Suitable guards such as 1/16" thick mild carbon steel back-up strip or layers of glass tape shall be used if necessary to prevent the root pass of the longitudinal seam weld of the sleeve from being deposited against the wall of the pipe.

4.5 Dents (Pipe Distortion)

4.51 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 a prolongation of the original contour of the pipe in any direction.

4.52 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 psig. Dents at welds in mains operating below 100 psig shall be treated the same as any other dent.

4.53 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 Welding and preheat on pipe while under pressure shall be as specified in SP 1602.

5.11 When the surface temperature of the pipe is less than 50°, the pipeline flow shall be made static and the pipe preheated and welded as set forth in SP 1602.

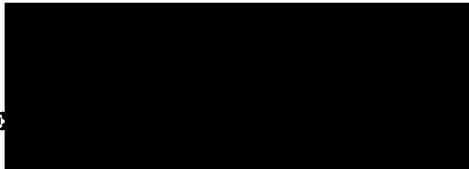
5.12 When the surface temperature of the pipe is less than 50°F, and the pipeline flow cannot be made static, all welding thereon shall be made using low hydrogen electrode in accordance with the procedures set forth in SP 1602.

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

6. Instructions for Field Application

Tabulations giving the maximum operating pressure permitted during the various welding operations for each transmission and principal distribution main within a division are recommended. 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.

APPROVE



DATE

6-17-63


VICE PRESIDENT - GAS OPERATIONS

CHART I

WELDING REPAIR SELECTION CHART FOR MAINS WITH
 MAXIMUM ALLOWABLE OPERATING PRESSURE OF 100 PSIG OR LESS

Type of Defect	Extent of Defect	Permissible Methods of Repair	Limitations on Method
1. Mechanical Damage Notches, Scratches, Gouges, Grooves.	a. Depth less than 50% of pipe wall thickness	1. Grinding	Less than 10% distortion or dent. Pipe wall not to be reduced to less than 50% thickness.
	b. Depth more than 50% of pipe wall.	1. Grinding & welding	Less than 10% distortion or dent. Repair not to exceed 1/4 circumference of pipe nor 5 square inches. Not more than one repair per foot of pipe length.
		2. Patching	Less than 10% distortion or dent.
		3. Sleeving	Less than 10% distortion or dent.
2. Corrosion Damage	a. Depth less than 50% of pipe wall	1. No repair required.	
	b. Depth more than 50% of pipe wall	1. Grinding & welding	Repair not to exceed 1/4 circumference of pipe nor 5 square inches. Not more than one repair per foot of pipe.
		2. Patching	No limitation.
		3. Sleeving	No limitation.
		4. Mueller Nipple	2" Maximum size.
3. Leaks in Welds	a. Porosity or pinholes	1. Patching	No limitation.
		2. Sleeving	No limitation.
		3. Mueller Nipple	2" Maximum size.
4. Cracked Welds	a. Seam or joint weld	1. Patching	No limitation.
		2. Sleeving	No limitation.
5. Leaks in body of fittings or in clamps		1. Canning or encasing	No limitation.
		2. Remove fitting	No limitation.



CHART II

WELDING REPAIR SELECTION CHART FOR MAINS WITH MAXIMUM ALLOWABLE OPERATING PRESSURE GREATER THAN 100 PSIG BUT DESIGN PRESSURE LEVEL LESS THAN 20% OF SPECIFIED MINIMUM YIELD STRENGTH OR 500 PSIG, WHICHEVER IS LESS

Type of Defect	Extent of Defect	Permissible Methods Of Repair	Limitations on Method
1. Mechanical Damage Notches, Scratches, Gouges, Grooves.	a. Depth less than 10% of pipe wall	1. Grinding	Less than 5% Distortion or Dent. Pipe wall not to be reduced to less than 90% thickness.
	b. Depth between 10% and 30% of pipe wall.	1. Grinding & Welding	Less than 5% Distortion or Dent. Repair not to exceed $\frac{1}{4}$ of pipe circumference nor 4 square inches. Not more than one repair per 5 pipe diameters of length.
		2. Patching - Main to be tapped so that patch carries pressure.	Patch not to exceed $\frac{1}{2}$ pipe circumference. No limit on length for pipe thru 8-5/8" O.D. Length not over 10 diameters on pipe over 8-5/8" O.D. Less than 5% distortion or dent. 6" minimum clearance.
	c. Depth over 30% of pipe wall.	3. Sleeving-Main to be tapped so sleeve carries pressure. 1. Patching 2. Sleeving	Less than 5% distortion or Dent. Main to be tapped so that sleeve carries pressure. Same as 1 b 2. Same as 1 b 3.
2. Corrosion Damage	a. Depth less than 20% of pipe wall.	1. No repair required.	
	b. Depth between 20% and 30% of pipe wall.	1. Grinding & welding.	Same as 1 b 1.
		2. Patching	Same as 1 b 2. No tapping of main required.
		3. Sleeving	No limitation. No tapping of main required.
		4. Mueller Nipple	2" Maximum size.
	c. Depth over 30% of pipe wall.	1. Patching	Same as 1 b 2. No tapping of main required.
2. Sleeving 3. Mueller Nipple		No limitation. No tapping of main required. 2" Maximum size.	
3. Leaks in Welds	a. Porosity or pinholes.	1. Patching	Same as 1 b 2.
		2. Sleeving	No limitation.
		3. Mueller Nipple	2" Maximum size.
4. Cracked Welds	a. Circumferential Welds	1. Sleeving	No limitation.
	b. Longitudinal Seam Welds	1. Patching	Patch must extend to $\frac{1}{2}$ of pipe circumference. No limit on length of patch for pipe thru 8-5/8" O.D. Length not to exceed 10 diameters on pipe over 8-5/8" O.D.
5. Leaks in body of fittings or in clamps		2. Sleeving	No limitation.
		1. Remove Fitting 2. Canning or encasing	No limitation. Approval required by Gas System Design Department

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CHART III

WELDING REPAIR SELECTION CHART FOR MAINS WITH DESIGN PRESSURE LEVEL
GREATER THAN 20% OF SPECIFIED MINIMUM YIELD STRENGTH OR OVER 500 PSI

Type of Defect	Extent of Defect	Permissible Methods Of Repair	Limitations on Method
1. Mechanical Damage Notches, Scratches, Gouges, Grooves.	a. Depth less than 10% of pipe wall	1. Grinding	Pipe wall not to be reduced to less than 90% thickness. Less than 2% distortion or dent.
	b. Depth over 10% of pipe wall	1. Patching - Main to be tapped so that patch carries pressure. 2. Sleeving - Main to be tapped so that sleeve carries pressure.	Specified minimum yield strength of pipe material not to exceed 45,000 psi. Patch not to exceed 1/4 of pipe circumference nor one pipe diameter in length. Less than 2% distortion or dent. 6" min. clearance. Less than 2% distortion or dent. Maximum space between pipe and sleeve is 1/8". Welds under sleeve ground smooth. Back-up strip behind longitudinal welds. Main to be tapped so that sleeve carries pressure.
2. Corrosion Damage	a. Depth less than 10% of pipe wall.	1. No repair required.	
	b. Depth over 10% of pipe wall.	1. Patching 2. Sleeving 3. Mueller Nipple	Same as 1 b 1. No tapping of main required. Same as 1 b 2. No tapping of main required. 2" Maximum size.
3. Leaks in Welds	a. Porosity or pinholes.	1. Patching	Same as 1 b 1.
		2. Sleeving	Same as 1 b 2.
		3. Mueller Nipple	2" Maximum size.
4. Cracked Welds	a. Circumferential Welds	1. Sleeving	Same as 1 b 2.
	b. Longitudinal Seam Welds	1. Replace Pipe	X-Ray Tie-in Welds
5. Leaks in body of fittings or in Clamps.		1. Remove Fitting	X-Ray Tie-in Welds