1 Scope

1 1 This standard covers repairs to or welding preheating and stress relieving on lines which are under 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 For seamless and double submerged arc welded pipe the maximum pressure permitted during welding shall be determined using the formula given below or a pressure which will produce a hoop stress of 50% of the specified minimum yield strength whichever is lower

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

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

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

2 2 Under the following conditions the maximum hoop stress permitted during welding shall not exceed 20% of the specified minimum yield strength

2 21 When welding within 3 of the longitudinal seam weld on any type of pipe except double-submerged arc welded pipe This limitation does not apply to circumferential welds when installing full encirclement fittings such as sleeves

2 22 When any defect (gouges corrosion laminations etc) 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

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PIPING- DATA SHEET
REPAIRS INCLUDING REPAIRS MADE BY WELDING ON MAINS UNDER PRESSURE
GAS STANDARD
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO CAL

SUPERSEDES
SUPERSEDED BY
SHEET No 1 of 4 SHEETS

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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 types of pipe

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 D-33 and A-34

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 have well rounded corners See Standard A-64

4 4 Sleeving

4 41 Sleeve design shall be in accordance with Gas Standard A-60

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 psi Dents at welds in mains operating below 100 psi 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 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 oxy-acetylene welding may be used --See D-20

5 11 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

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 D-22

5 2 All pipe having a wall thickness greater than 500 shall be preheated before and during welding

5 3 Any welding on X60 pipe which is in service should be performed with either low hydrogen E7018 electrodes or the line flow should be made static If done with cellulose electrodes, make line static preheat pipe to at least 200°F and weld with E7010 electrodes

6 Instructions for Field Application

Tabulations giving the maximum operating pressure permitted during the various welding operations for each transmission and principal distri-

bution 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

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