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

* Paragraph Revised
** Paragraph Added

APPROVED BY	7	4 15 88	Revised as indicated							
	6	2/5/87	Added Paragraph 2.1 & Renumbered							
	5	4/30/85	Chg'd "D to Non Outside Dia per Suggestion							
	REV	DATE	DESCRIPTION	GM	OWN.	CHKD	SUPV	APVD

GM				B/M	
SUPV		PIPING - DATA SHEET	DWG. LIST	
DSGN		REPAIR OF PIPELINE DEFECTS	SUPSDS	
DWN			SUPSD BY	
CHKD		GAS STANDARDS	SHEET NO 1 of 5 SHEETS	
O K		PACIFIC GAS AND ELECTRIC COMPANY	DRAWING NUMBER	REV
DATE 0/.2/07	SCALE	SAN FRANCISCO CALIFORNIA	034491	7

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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 <u>seamless</u> and <u>double submerged arc welded pipe</u> 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

* Paragraph Revised

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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

* Paragraph Revised

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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 400 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 50^0 the pipeline flow should be made static and
the pipe preheated and welded as set forth in D-22

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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

* Paragraph Revised
** Paragraph Added
*** Paragraph Renumbered

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