PURPOSE

1. To establish a uniform procedure for designing and testing gas piping systems that will meet the requirements of G.O. 112C §192.101 and §192.501 of the CPUC.

RESCISSION

2. Supersedes earlier letter and instructions, including:
   a. Letter, April 2, 1962, [redacted] to Division Gas Superintendents, "Marking Estimates for Work on Piping Systems Designed to Operate at Stress Levels Over 20% of the Specified Minimum Yield Strength".
   b. Letter, May 4, 1962, [redacted] to Division Gas Superintendents, "Replacement of Pipe in Mains Operating at Stress Levels Over 20% of the Specified Minimum Yield Strength".
   c. Letter, March 25, 1936, [redacted] to Division Managers, calling attention to the serious consequences that may result when main or services are damaged.

POLICY AND APPLICATION

3. All gas piping systems and facilities both new and reconstructed are to be designed and tested in accordance with the requirements of G.O. 112C. This includes the reinstating of abandoned or temporarily disconnected piping.

RESPONSIBILITY

4. *The Supervisor in charge of engineering* and installation shall be responsible for design and testing, respectively, of pipe facilities in accordance with this Standard. Other provisions required by G.O.112C of the CPUC shall be observed.

DEFINITIONS

5. The following definitions shall apply to this Standard:
   a. Stress is the resultant internal force that resists change in size or shape of a body acted on by external forces.
   b. Operating stress is the stress in a pipe or structural member under normal operating conditions.
   c. Hoop stress is the stress in a pipe wall, acting circumferentially in a plane perpendicular to the longitudinal axis of the pipe and produced by the pressure of the fluid in the pipe.
   * d. Design Pressure is the maximum operating pressure permitted by G.O. 112C as determined by the design procedures applicable to the material and locations involved.
   * e. Maximum Allowable Operating Pressure (MAOP) is the maximum pressure at which a gas system may be operated in accordance with the provisions of G.O. 112C.
   * f. Maximum Operating Pressure (MOP) is the maximum pressure at which a system may be operated as specified by the Manager of G.S.D. Department.
   g. Test Medium is a substance such as water, air, or gas through which a force acts to leak or strength test a facility.
   h. Test Pressure is the internal fluid pressure specified for testing.
   i. Strength Test is a pressure test to prove the mechanical strength of the system.
   j. Leak Test is a pressure test to determine the tightness of the system.
   k. Location Class is a geographic area as classified and described in G.O. 112C §192.5.
   l. Construction Type is a construction specification for pipeline and mains that fixes the stress levels.
   m. Specified Minimum Yield Strength (SMYS) is the minimum yield strength prescribed by the specification under which the pipe is purchased from the manufacturer (psi).

* Standard Practice 463-8 gives a complete description of these terms and their application. (S.P. 463-8 is included in the "ENGINEERS ESTIMATORS MANUAL").

APPROVED [redacted]	CHG	DATE	DESCRIPTION	BY	CH.	APPD.
	3	2-20-74	Added Footnote Concerning M.A.O.P., M.O.P. and Design Pressure.	AC.	A.N.K.	[redacted]
	2	2-17-72	Revised Title For Computer Listing, Also Paragraphs 1, 3, & 5e		M.C.	9LL
	1	9-10-70	Revised Par. 5f.			8XX

SUPV. BY
DSGN.
DR.
CH.
O.K.
DATE 2-11-69
SCALE NONE

PIPING — DATA SHEET

DESIGN AND TEST REQUIREMENTS

GAS STANDARD

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

SUPERSEDES 084509
SUPERSEDED BY
SHEET NO. 1 OF 4 SHEETS
DRAWING NUMBER 283621
CHANGE 3

A-34

DESIGN

6. When determining MAOP consideration shall be given to:

   a. Future development of the area.

   b. Current and future Gas Supply Pressures.

   c. Probability of increase in Supply Pressure.

a. Design criteria statement must appear on drawings for all facilities where strength testing is required.

7. Initial Construction

   Design all gas facilities to meet the requirements of the expected future location class.

8. Addition to Existing Facilities

   The design requirements for subsequent additions or alterations to existing pipeline facilities shall be at least equivalent to that of the original construction, or the expected future M.A.O.P. of the line.

9. Facilities designed for either Location Class 1 and 2 or which deviate from the steel pipe specification (Appendix B,C,D,E and F) shall be submitted to the Gas System Design Department for approval.

10. Pressure ratings for fittings, valves, and other piping components shall be equal to or greater than the design pressure established for the piping system.

TESTING

11. The test medium shall be one permitted for the design pressure and location class as specified in G.O. 112C §192.503. Factors to be considered in the choice of test media, as shown in the table of test requirements (Appendix A) shall include safety, availability, and economy.

12. Test Pressure shall not be less than that required by G.O. 112C §192.501 to test the tightness and strength of a system. Except as modified by paragraph 13, all lines shall be tested in accordance with Appendix A.

11. Welds must be inspected as required by Std D-31, section 6.

13. Exceptions:

Short replacement shall be treated as follows.

a. Replacement section of pipe shall be subjected to a preinstallation strength test. The section of replacement pipe shall be tested to the pressure required for a new pipeline or main installed in the same location by maintaining the pressure at or above the test pressure for at least four hours. The test may be made on the replacement pipe prior to installation provided all tie-in girth welds are nondestructively tested.

b. Minimum test duration for pipe to be held for emergency use is four hours. Minimum Test Pressure shall be at least equal to the Test Pressure required for the line in which it is used.

c. Replacement section of pipe to be operated at less than 30% S.M.Y.S. and over 100 P.S.I.G. shall be given a one hour Preinstallation Leak Test.

14. All gas service lines that have been hit, bent, pulled, dented, broken or otherwise damaged, which are to remain in service; shall be leak tested in accordance with Appendix A from tee to riser. The test shall be performed even though a repair was not made to the service.

DESIGN CRITERIA:

LOCATION CLASS _____

DESIGN FACTOR _____

D.P. _____ % SMYS _____

MAOP _____ % SMYS _____

STRENGTH TEST PRESSURE

MAX. _____ PSIG _____ %SMYS

MIN. _____ PSIG _____ %SMYS

_____ PSIG = 90% SMYS

TEST FLUID _____

PIPE SPEC. _____

O.D. _____

W.T. _____

RECORDS

15.a. For facilitjes operating above 100 P.S.I., estimate sketches and design drawings shall contain the following information:
Where more than one size or type of pipe is involved, the Required Information shall be supplied for each size or type. Where several sizes are involved the Information should be provided in Tabular Form.

b. Leak Test Information shall be recorded on the gas service record, the estimate sketch, and work order or other authorized form for facilities operating under 100 P.S.I.G.

c. Estimate Form 62-6251 shall be marked by person making estimate to indicate that the pipe is over 30% yeld and has to be strength tested.

Changed, Added & rearranged 8-21-74 AK

6a = 11

5 Added Note 5; changed previous Note 11 to 12a

CHG	DATE	DESCRIPTION	BY	CH.	APPD.
4	9-11-73	Revised Par. 14, 8 and 12.	A.C.	A.N.K.	
3	1-22-73	Revised Paragraph 9 and 13; Added Paragraph 14 and 15.	A.N.K.		
2	2-17-72	Revised Title For Computer Listing & Paragraphs 11, 12 & K.		M.C.	
1	9-10-70	Revised Par. 13a			

APPROVED

SUPV. BY

DSGN.

DR.

CH.

O.K.

DATE 2-11-69

SCALE NONE

PIPING — DATA SHEET

DESIGN AND TEST REQUIREMENTS

GAS STANDARD

PACIFIC GAS AND ELECTRIC COMPANY

SAN FRANCISCO, CALIFORNIA

SUPERSEDES 084509

SUPERSEDED BY

SHEET NO. 2 OF 4 SHEETS

DRAWING NUMBER 283621

CHANGE ~~4~~ 5

STRENGTH TEST PRESSURE REPORT.

16. A Strength Test Pressure Report (Form 62-4921) is required for each facility operating at over 100 P.S.I.G. (See Appendix A).
    a. Part I of the Strength Test Pressure Report shall be filled out by the Project Engineer or the Gas System Design Department.
    b. Part II of the Strength Test Pressure Report shall be filled out by the person supervising the test in the field, at the time the Test is performed.
    c. A copy of the completed Strength Test Pressure Report shall be filed with the completed Foreman's Copy of the Estimate, along with a copy of the Test Chart (where required). These shall be retained for the life of the facility. Distribute other copies as indicated on the Form.

TEST CHART

17. A Chart Record shall be made of the Pressure Test for new facilities to operate at over 30% S.M.Y.S. and for all lines or systems being uprated. The procedure for handling the Chart, and the minimum information required on the Chart is outlined below:
    a. The Chart must be designed for the recorder on which it is to be used, and must have appropriate scale and time lines.
    b. The calibration of the recorder must have been checked.
    c. The Chart must be set on the correct time at the start of the test. The actual time, date, and initials of the person starting the test must be shown on face of Chart at the start of the test.
    d. The Chart must show a minimum of eight hours (except where four hours test is permitted in Appendix A.). Any discrepancies should be explained.
    e. At the end of the test, the actual time, date, and initials of the person removing the Chart must be shown on the face of the Chart.
    f. The section of pipe under test must be identified on the face of the Chart, along with the Job Number.
    g. The following additional information is to be shown on the back of the Chart.
        I. Job Number
        II. Location of test.
        III. Test Pressure, date and duration.
        IV. Size, wall thickness, pipe specification and length of section tested.
        V. The serial number of the recorder or other means of identification.
        VI. The date the recorder was last calibrated and s/n of the dead weight tester used.
    h. The above information is to be recorded on the Chart at the time of the test. After the test is completed, the foreman is to review the Chart and then sign and date it.
    i. The original of the Test Chart is to be attached to the original of the Test Report Form 62-4291. A copy of the Test Chart is to be attached to each copy of the Test Report. This Record is to be retained for the life of the facility.

TEST RECORDS FOR FACILITIES OPERATING AT UNDER 100 P.S.I.G.

18. For each facility operating at under 100 P.S.I.G., the Leak or Pressure Test Information shall be recorded in a Box provided on the Work Order Form or the Gas Service Record Form. If these documents are not used, the Test Information shall be recorded on the As-built Copy of the Construction drawing. The Test Record shall be retained for the life of the facility.

APPROVED	CHG	DATE	DESCRIPTION	BY	CH.	APPD.
[redacted]	3	2-20-74	Added Paragraph 18.	AC.	A.N.K.	[redacted]
	2	7-25-73	Paragraph 15 Removed, Paragraph 16 and 17 Added; Drawing Redrawn.	A.N.K.	M.C.	
	1	2-17-72	Revised Title For Computer Listing & Revised Design Criteria		M.C.	

SUPV. BY	PIPING — DATA SHEET	SUPERSEDES 084509	
DSGN.	DESIGN AND TEST REQUIREMENTS	SUPERSEDED BY	
DR. [redacted]	GAS STANDARD	SHEET NO. 3 OF 4 SHEETS	
CH. M.C.	PACIFIC GAS AND ELECTRIC COMPANY	DRAWING NUMBER	CHANGE
O.K. [redacted]	SAN FRANCISCO, CALIFORNIA	283621	3
DATE 2-11-69	SCALE NONE		

TEST REQUIREMENTS FOR PIPELINES, MAINS, SERVICES AND OTHER FACILITIES.

DESIGN PRESSURE		30% S.M.Y.S. OR MORE		UNDER 30% S.M.Y.S. AND OVER 100 P.S.I.	100 P.S.I. TO 1 P.S.I. OR LESS	PLASTIC (SEE NOTE 9)
		PIPELINE	FABRICATED UNITS, SHORT SECTIONS OF PIPE, PRETESTED PIPE (SEE NOTE 5 FOR LIMITATION)			
TYPE OF TEST		STRENGTH	STRENGTH	LEAK	LEAK	STRENGTH
TEST MEDIUM		WATER, AIR, INERT GAS OR GAS (SEE NOTES 1 AND 2)	WATER, AIR, INERT GAS OR GAS (SEE NOTES 1 AND 2)	WATER, AIR, INERT GAS OR GAS (SEE NOTES 1 AND 2)	AIR OR GAS	AIR OR GAS
MAXIMUM TEST PRESSURE (SEE NOTES 1 AND 2)		100% S.M.Y.S. OR FACTORY TEST PRESSURE OF FITTING (SEE NOTES 3 AND 4)	100% S.M.Y.S. OR FACTORY TEST PRESSURE OF FITTING (SEE NOTES 3 AND 4)	(SEE NOTES 3 & 11)	110 P.S.I.	3 X DESIGN PRESSURE
MINIMUM TEST PRESSURE		1.5 X DESIGN PRESSURE (SEE NOTE 4)	1.5 X DESIGN PRESSURE (SEE NOTE 4)	1.5 X DESIGN PRESSURE	100 P.S.I.	~~100~~ 50 P.S.I. OR (13) 1.5 X M.A.O.P., WHICHEVER IS GREATER
DURATION OF TEST		8 HOURS MINIMUM	4 HOURS MINIMUM	1 HOUR MINIMUM	5 MINUTES	5 MINUTES (SEE NOTE 6)
TEST RECORDS REQUIRED (SEE NOTE 12)	FORMS REQUIRED	COMPLETED STRENGTH TEST PRESSURE REPORT	COMPLETED STRENGTH TEST PRESSURE REPORT	COMPLETED STRENGTH TEST PRESSURE REPORT	COMPLETE BOX ON W.O. FORM OR GAS SERVICE RECORD FORM	COMPLETE BOX ON W.O. FORM OR GAS SERVICE RECORD FORM
	TEST CHART	YES (SEE NOTE 8)	YES (SEE NOTE 8)	NO (SEE NOTE 10)	NO (SEE NOTE 10)	NO (SEE NOTE 10)

NOTES: (1) Maximum Test Pressure permitted, expressed as a percent of S.M.Y.S.-

Location Class	1	2	3	4
Air or Inert Gas	80	75	50	40 (SEE NOTE 7)
Gas	80	30	30	30
WATER	See Above.			

(2) Safety - when testing with air, inert gas or gas, the pressure shall be held at about 100 P.S.I. and observed for leakage before raising to the required test value.

(3) Maximum test capabilities of fittings such as valves and elbows must be examined when testing.

(4) It is the intent to test all facilites designed to operate at over* 50% S.M.Y.S. at a pressure over 90% of S.M.Y.S. and as close to S.M.Y.S. as practical. There may be instances, as in item 3, where pressure shall be limited, but in no case shall it be less than 1.5 D.P. (Except Class 1 Construction, which is 1.25 D.P.). Facilities to operate at under 50% S.M.Y.S. shall be tested to a minimum of 1.5 X D.P.

(5) Where practical, all facilities must be tested as a unit, after installation. For fabricated units and short sections of pipe, for which a post installation test is impractical, a preinstallation strength test must be conducted by maintaining the pressure at or above the minimum required for at least four hours.

(a) A short section of pipe is defined as one pipe length or less.

(b) A fabricated unit is made up of two or more fittings and/or pieces of pipe joined together.

(6) Hold at test pressure for as long as practical. If not gassed up immediately following test, retest before gassing up.

(7) Air or inert gas should not be used to test at over 50% S.M.Y.S. unless a test with water is completely impracticable. When it is necessary to use air or inert gas at over 50% S.M.Y.S., buildings within 300' of pipeline must be evacuated.

(8) Test Charts must be completed and retained as outlined in A-34, page 3.

(9) Temperature of thermoplastic material must not be more than 100°F during the test.

(10) Table indicates Test Chart Requirements for new facilities. Test Charts are required for All uprating jobs, no matter what the Operating Pressure of the line.

(11) For facilities operating at under 30% S.M.Y.S. and over 100 P.S.I., the Maximum Test Pressure is to be determined by the Project Engineer. A reasonable differential between Maximum and Minimum Test Pressures should be allowed, considering elevation differentials and Note 3.

(12) All Test Records must be Retained for the life of the facility.

(13) SDR 21 PIPE TO BE TESTED TO 50 PSIG. MINIMUM.

* For facilities operating at 40% to 50% of S.M.Y.S., consideration should be given to testing to over 90% of S.M.Y.S. if there is a potential for high rise construcion. However, such testing is not an alternative for construction of new or replacement facilities to meet expected future location class requirements (see page 2, par. 7 of this standard).

7 Change Minimum test Pressure for Plastic from 100psi

CHG	DATE	DESCRIPTION	BY	CH.	APPD.
7		Change Minimum test Pressure for Plastic from 100psi			
4	2-17-72	Revised Title For Computer Listing, Change To 30 SMYS & Note 4		M.C.	[illegible]
6	2-26-74	Revised Chart to Show Required Test Forms, Added Notes 11 & 12 and Footnote; Max. Test for 100 P.S.I. to 30% S.M.Y.S. & 1 to 100 P.S.I. Changed from 1.5 D.P. & 100 P.S.I.	A.C.	A.N.K.	
5	1-24-73	Drawing Revised and Redrawn.	A.N.K.		

APPROVED

changed. 5-15-74. A.K.

SUPV. BY
DSGN.
DR.
CH.
O.K.
DATE 2-11-69
SCALE NONE

PIPING — DATA SHEET

DESIGN AND TEST REQUIREMENTS

GAS STANDARD

PACIFIC GAS AND ELECTRIC COMPANY

SAN FRANCISCO, CALIFORNIA

SUPERSEDES 084509

SUPERSEDED BY

SHEET NO. 4 OF 4 SHEETS

DRAWING NUMBER 283621

CHANGE 6

7

STEEL PIPE SPECIFICATION

A.P.I. 5LX GRADE X65. 36" - 42" D.S.A.W. 65,000 S.M.Y.S.

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAMETER (INCHES)	WALL THICKNESS (INCHES)	MILL TEST PRESSURE (P.S.I.G.)	PRESSURE AT % OF S.M.Y.S.							
				CLASS LOCATION:		1	2	3	4		
				100%	90%	72%	60%	50%	40%	30%	20%
36	36.0	.312	1010	1127	1014	811	676	564	451	338	225
		.375	1220	1354	1219	975	812	677	542	406	271
		.500	1620	1806	1625	1300	1084	903	722	542	361
42	42.0	.375	1040	1161	1045	836	697	581	464	348	232
		.500	1390	1548	1393	1115	929	774	619	464	310

NOTES:

1. THE SYMBOLS AND ABBREVIATIONS USED IN THIS TABLE HAVE THESE MEANINGS:
   E.R.W. -ELECTRIC RESISTANCE WELDED.
   D.S.A.W. -DOUBLE SUBMERGED ARC WELDED.
   S.M.Y.S. - SPECIFIED MINIMUM YIELD STRENGTH.
   20%, 30%, ...ETC. - 20%, 30%... OF SPECIFIED MINIMUM YIELD STRENGTH.
2. A-25 AND X42 ARE THE MOST ECONOMICAL CHOICES FOR MOST APPLICATIONS THROUGH 10". GRADE B IS NORMALLY USED WHEN SCHEDULE 40 PIPE IS REQUIRED. X52. X60. AND X65 BECOME DESIRABLE AS DIAMETERS AND OPERATING PRESSURE INCREASE..
3. OTHER COMBINATIONS OF SIZE. GRADE. AND WALL THICKNESS ARE AVAILABLE. GAS SYSTEM DESIGN SHOULD BE CONSULTED IF PIPE THAT IS NOT SHOWN IS TO BE USED. OR IF THERE IS A QUESTION AS TO THE MOST ECONOMICAL GRADE AND WALL THICKNESS FOR A PARTICULAR APPLICATION. SEE NOMOGRAPH. PAGE 10. FOR DESIGN PRESSURE OF PIPE NOT COVERED IN TABLES.
4. WHEN SPECIFYING PIPE. THE FOLLOWING INFORMATION SHALL BE GIVEN IN SEQUENCE:
   A). A.P.I. SPECIFICATION AND GRADE.
   B). LONGITUDINAL SEAM WELDING PROCESS.
   C). OUTSIDE DIAMETER AND WALL THICKNESS.
   D). COATING (BARE. X-TRU COAT. PLASTIC TAPE WRAP. ETC.).

The type of coating (other than specifying bare or coated) is not required when ordering for routine applications as the standard coating will be supplied. However, the type of coating for each installation must be recorded in the permanent records.

EXAMPLES:

A. A.P.I. 5LX GRADE X42. E.R.W. 16" O.D. X .250 W.T. PLASTIC TAPE WRAPPED. COATED } Typical Specification on an Order.

B. A.P.I. 5L GRADE B SEAMLESS. A-25 Continuous Weld 2" O.D. X .154 W.T. X-TRU COAT } Typical specification for Permanent Records.

2.375

D) BARE OR COATED (coating type not needed for ordering but needed for records)

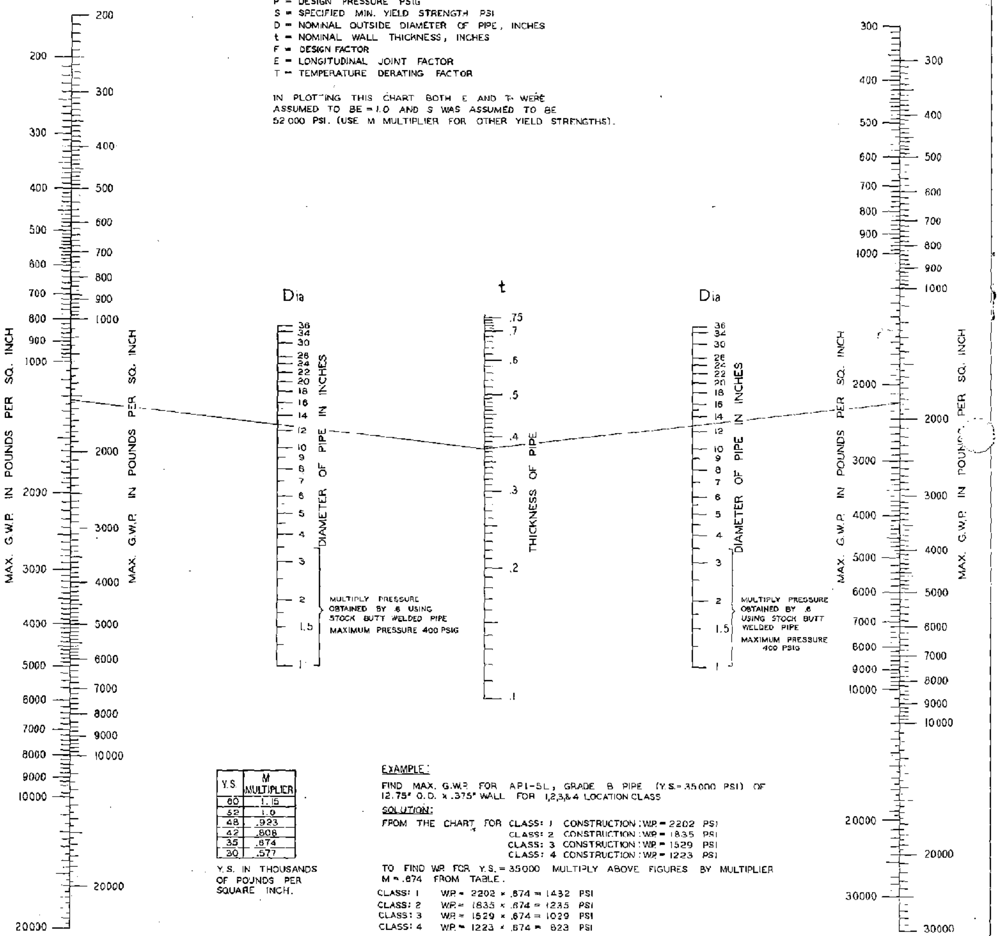
C. 4.50" OD X .237 WT, API 5L Grade B, Seamless, Bare } Typical Bare pipe specification for either orders or records

changed and added. 6-4-74. AK.

APPROVED BY						
	CHG	DATE	DESCRIPTION	BY	CH.	APPD.

SUPV. BY		PIPING-DATA SHEET	SUPERSEDES
DSGN.		STEEL PIPE-A.P.I. 5LX GRADE X 65	SUPERSEDED BY
DR. [redacted]		GAS STANDARD	SHEET NO. 5 OF 5 SHEETS
CH. M. C.		PACIFIC GAS AND ELECTRIC COMPANY	DRAWING NUMBER 283253 / CHANGE 1
O.K. [redacted]		SAN FRANCISCO, CALIFORNIA	
DATE 2-21-73	SCALE NONE		

1 Revised Note 4



$P = \frac{2St}{D} \times F \times E \times T$

P = DESIGN PRESSURE PSIG
S = SPECIFIED MIN. YIELD STRENGTH PSI
D = NOMINAL OUTSIDE DIAMETER OF PIPE, INCHES
t = NOMINAL WALL THICKNESS, INCHES
F = DESIGN FACTOR
E = LONGITUDINAL JOINT FACTOR
T = TEMPERATURE DERATING FACTOR

IN PLOTTING THIS CHART BOTH E AND T WERE ASSUMED TO BE = 1.0 AND S WAS ASSUMED TO BE 52 000 PSI. (USE M MULTIPLIER FOR OTHER YIELD STRENGTHS).

Y.S.	M MULTIPLIER
60	1.15
52	1.0
48	.923
42	.808
35	.674
30	.577

Y.S. IN THOUSANDS OF POUNDS PER SQUARE INCH.

EXAMPLE:

FIND MAX. G.W.P. FOR API-5L, GRADE B PIPE (Y.S.=35000 PSI) OF 12.75" O.D. x .375" WALL FOR 1,2,3,&4 LOCATION CLASS

SOLUTION:

FROM THE CHART, FOR CLASS: 1 CONSTRUCTION: WP = 2202 PSI
CLASS: 2 CONSTRUCTION: WP = 1835 PSI
CLASS: 3 CONSTRUCTION: WP = 1529 PSI
CLASS: 4 CONSTRUCTION: WP = 1223 PSI

TO FIND WP FOR Y.S. = 35000 MULTIPLY ABOVE FIGURES BY MULTIPLIER M = .674 FROM TABLE.

CLASS: 1 WP = 2202 x .674 = 1432 PSI
CLASS: 2 WP = 1835 x .674 = 1235 PSI
CLASS: 3 WP = 1529 x .674 = 1029 PSI
CLASS: 4 WP = 1223 x .674 = 823 PSI

[redacted]

* CLASS 1 & 2 NOT FOR USE WITHOUT APPROVAL OF G.S.D.D.
DESIGN FACTOR AS DEFINED IN G.O. 112C § 192.111

TABLE OF CHANGES

PIPING — DATA SHEET
MAXIMUM G.W.P. FOR PIPE BASED ON DESIGN FACTOR
GAS STANDARD
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

DATE 3-5-65

385210