


Design and Test Requirements Table of Contents

	Page
1. Purpose	2
2. Rescission	2
3. Policy and Application	2
4. Responsibility	2
5. Definitions	2
6. Design	3
7. Inspection	3
8. Testing	3
9. Test Limitations on Valves	4
10. Records	5
11. Test Chart	5
12. Appendix List	6

REV.	DESCRIPTION	APPROVED BY	DATE
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 PIPING DESIGN AND TEST REQUIREMENTS		GAS TRANSMISSION	
		DOCUMENT NUMBER - PAGE 087950 1	

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1. Purpose

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

Note: The CPUC G.O. 112 also requires written and verbal notification of certain work. See Gas Standard A-34.1 for these requirements

To establish basic guidelines for pipeline construction drawings.

2. Rescission

Supersedes any previous instructions which are contrary to this Standard.

3. Policy and Application

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

4. Responsibility



- A. The Engineer responsible for the design of a facility shall specify the test or tests required, in accordance with this standard. For all facilities to be tested to support an MAOP of 100 psig or greater, the Engineer shall prepare a Strength Test Report (Form 62-4921) for each test required. Part I - Design Data, shall be filled out to include all applicable information. These reports shall accompany the construction drawings to the field.
- B. The Supervisor responsible for the construction of the facility shall have the responsibility for testing it in accordance with this standard. Prior to testing any facility which is to be tested to support an MAOP of 100 psi or greater, the Supervisor shall verify that a Strength Test Pressure Report (Form 62-4921), with Part I (Design Data) completely filled out, is available at the job site. The Supervisor shall verify that the pipe specifications and footages are correct before proceeding with the test. Upon completion of the test, the Supervisor is responsible for the completion of Part II - Test Data, of the Strength Test Pressure Report.
- C. The Engineer and the Construction Supervisor are responsible to ensure that all other applicable provisions of CPUC General Order 112 (latest edition) are followed when designing, constructing and testing a facility.

5. Definitions

The following definitions shall apply to this Standard.

- A. **Stress** is the magnitude of the internal forces that act to change in size or shape, 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**¹ is the maximum operating pressure permitted by G.O. 112 as determined by the design procedures applicable to the pipe size, wall thickness, material, and location involved.
- E. **Maximum Allowable Operating Pressure**¹ (MAOP) is the maximum pressure at which a gas pipeline segment may be operated in accordance with the provisions of G.O. 112.
- F. **Maximum Operating Pressure**¹ (MOP) is the maximum pressure at which a system may be operated as specified by the Manager of Gas System Design Department.
- G. **Test Medium** is a substance such as water, air, or gas used to exert an internal pressure 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. **Class Location** is a geographic area as classified and described in G.O. 112, Section 192.5, and Standard Practice 460-1.
- L. **Design Factor** is the percentage of SMYS to which operating stress must be limited, as further described in G.O. 112, Section 192.111.
- M. **Specified Minimum Yield Strength** (SMYS) is the minimum yield strength prescribed by the specification under which the pipe is manufactured and qualified to be sold.

¹ 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").

REV.	DESCRIPTION	APPROVED BY	DATE
5	Retyped and revised per suggestion		11-2-92
 PIPING DESIGN AND TEST REQUIREMENTS		GAS TRANSMISSION	
		DOCUMENT NUMBER - PAGE 087950 2	

Converted to Interleaf

6. Design

A. Design criteria stamps for all sizes, specifications, grades, seam types and wall thickness of pipe shown on specific Plan & Profile/Sections sheet. A design criteria stamp is required for each MAOP and for each test pressure.

B. When determining design requirements to establish the MAOP, consideration shall be given to:

1. Future development of the area.
2. Current and future gas supply pressures.
3. Probability of increase in supply pressure.

C. The design formula for steel pipe is given below:

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

- Where:
- P = design, pressure, psig
 - S = specified minimum yield strength, psi
 - D = outside diameter, inches
 - t = nominal wall thickness, inches
 - F = design factor determined in accordance with Section 192.111 of G.O. 112.
 - E = longitudinal joint factor determined in accordance with Section 192.113 of G.O.112.
 - T = temperature derating factor determined in accordance with Section 192.115 of G.O. 112.

D. Initial Construction

The design of all new gas facilities and any subsequent additions or alterations to existing facilities shall meet the expected future Class location and at least the planned future MAOP requirements of the pipeline. Use approved pipe shown in Appendices B,C,D,E,F, and G.

E. Requirements for Pipeline Construction Drawings

Appendices I, J, and K give the content, format, technical and professional engineering review requirements for pipeline plan and profile construction drawings. For other drawing requirements see Estimates - 4 of the Engineers' Estimators' Manual.

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. _____

WELD INSPECTION (GAS STD. D-40)*

RADIOGRAPHIC REQUIRED

20% MIN.

100%

*VISUALLY INSPECT A MINIMUM OF 20% OF ALL WELDS THAT ARE NOT RADIOGRAPHICALLY INSPECTED. (THIS REQUIREMENT APPLIES EVEN IF NO RADIOGRAPHIC INSPECTION IS REQUIRED).

Fig. 1
Design Criteria Stamp

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

7. Inspection

- A. Welds must be inspected as required by Gas Standard D-40.
- B. Trench, pipe and pipe coating must be inspected as required by Gas Standard A-36.

8. Testing

- A. All new, replaced, or reconnected pipelines and facilities transporting natural gas must be tested in accordance with the requirements in this standard. Except as noted in Notes 6 and 7 of

REV.	DESCRIPTION	APPROVED BY	DATE
5	Retyped and revised per suggestion	[Signature]	11-2-92
PIPING DESIGN AND TEST REQUIREMENTS		GAS TRANSMISSION	
		DOCUMENT NUMBER - PAGE 087950 3	

Converted to Interleaf

Appendix A, the test shall be conducted after the pipeline and/or facilities have been installed.

- B. The test medium shall be one permitted for the design pressure and Class location as specified in Appendix A. 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.
- C. Test pressure shall not be less than that required by Appendix A to test the tightness and strength of a system. All lines shall be tested in accordance with Appendix A.
- D. Pipe held for emergency use must be tested as specified in Appendix A.
- E. Girth welds used to tie-in fabricated units and short sections of pipe shall be inspected as required by Gas Standard D-40.
- F. Pipelines should normally be tested as required to support an MAOP equal to the design pressure. Testing to support only a lower MAOP is acceptable, but would require an additional test or uprating procedure to justify any subsequent increases in the MAOP.
- G. Testing of Facilities Damaged by Construction Work

- 1. All facilities known or suspected to have been struck during excavation or construction activities must be checked to assure their safety if they are to remain in service.

2. Transmission and Distribution Lines

The inspection, repair and testing required for a damaged transmission or distribution line will depend on the extent of the damage and other conditions, which can best be determined by the responsible Supervisor in the field. However, adequate steps must be taken either by testing or leak survey to insure that no leakage is present.

- (a) Repairs to damaged steel transmission or distribution lines shall be made in accordance with Gas Standard A-65.
- (b) Repairs to damaged plastic mains shall be made in accordance with Gas Standard A-93.1.
- (c) Special attention shall be given to a damaged casing for a plastic insert, to make certain that the damage did not result in a failure in the plastic at

another location remote from the point of contact.

3. Service Lines (including service risers)


- (a) If a steel, copper, or other metallic service line or the casing for a metallic insert has been broken, bent, pulled, crushed, or otherwise deformed, the service must be tested from tee to riser in accordance with Appendix A.
- (b) Steel, copper, or other metallic service lines or casings for metallic inserts that have been hit but not moved or deformed may be leak surveyed with a leak detector as an alternate check. The survey should include the entire length of the service and adjacent areas as appropriate.

4. See Gas Standard A-93.1 for plastic lines and plastic inserts. Also, refer to Gas Standard A-93.1 for plastic service risers which may have been exposed to excessive heat.

5. All service risers that have been struck and/or damaged in above ground incidents shall be leak surveyed with a leak detector. The survey shall include the service line adjacent to the customer's building and/or other areas as appropriate.

9. Test Limitations on Valves

- A. When performing a hydrostatic test on a line, the test pressure to which a valve may be subjected shall not exceed the manufacturer's shell test pressure, which are shown in Section F of the Gas Standards. Where the required MAOP of the line cannot be established because of these limitations, an engineering study shall be made to verify that it is safe to subject the valve to the higher pressure during the test. When making this study, consideration shall be given to the pressure to which the valve was tested by the manufacturer, the age and condition of the valve, and the effect of stresses which may be transmitted to the valve by the pipeline.
- B. When performing a test with air or inert gas, or an uprating with natural gas, the pressure to which a valve may be subjected shall be limited to 110% of the maximum working pressure of the valve. Where required MAOP of the line cannot be established because of this limitation, the matter shall be reviewed with the Gas System Design Department, to determine

REV.	DESCRIPTION	APPROVED BY	DATE
5	Retyped and revised per suggestion	<i>DJA</i>	11-2-92
 PIPING DESIGN AND TEST REQUIREMENTS		GAS TRANSMISSION	
		DOCUMENT NUMBER - PAGE 087950 4	

Converted to Interleaf

whether a higher test pressure may be permitted. This limitation shall not apply to the 100 psig air test on a service line.

- C. When a valve is to be subjected to a test pressure which is greater than its maximum working pressure, it shall normally be in the open position. However, in some cases, with prior approval from the Gas System Design Department, closed valves may be subjected to hydrostatic test pressure exceeding their rating working pressure, depending on the type and condition of the valve and with the limitations that the differential pressure must not exceed the working pressure and the test pressure must not exceed the manufacturer's shell test pressure.

10. Records

A. Facilities Designed to Operate at 100 PSIG or Greater

1. Estimated sketches and design drawings shall contain the following information: specifications of pipe, fittings, and valves, design pressure, MAOP, Class location, design factor and strength or leak test information. Where more than one size of pipe is involved, the requires information shall be supplied for each size and type.
2. A Strength Test Pressure Report (Form 62-4921) is required for each facility being tested to support an MAOP of 100 psig or greater (see Appendix A). For instructions on completing the Strength Test Pressure Report, refer to Mains-9 of the Engineers-Estimators Manual.
3. If the line is to have an MAOP equivalent to 30% or more of its SMYS, a test chart in accordance with Section 11.0 is required.
4. If any portion of a line is tested to over 90% SMYS, a dead weight tester (DWT) shall be in service continuously during the test in addition to the pressure recording chart. A log of the DWT reading shall be made every 1/2 hour. The pressure recording chart and the DWT log shall be submitted with the Strength Test Pressure Report. The DWT log shall be considered the official record of the test. In the event that the DWT fails during the test, the pressure recording chart may be accepted as the official test record.

5. Estimate Form 62-6251 shall be marked by the person making the estimate to indicate if the pipe has to be strength tested.

B. Facilities Designed to Operate at Less Than 100 PSIG

For for facilities designed to operate at less than 100 psig, test information shall be recorded on the gas service record, the estimated sketch, and work order or other authorized form.

- C. For systems being uprated, a test chart in accordance with Section 11.0 is required.
- D. All required test records shall be retained for the useful life of the facility.

11. Test Chart

For pipelines being tested or uprated to support an MAOP equivalent to 30% of SMYS or greater, a chart record shall be made of the pressure test. 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 the chart at the start of the test.
- D. The chart must show a minimum of eight hours (except where a four hour 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:
 1. Job number
 2. Location of test
 3. Test pressure, date and duration
 4. Size, wall thickness, pipe specification, and length of section tested.
 5. The serial number of the recorder or other means of identification

REV.	DESCRIPTION	APPROVED BY	DATE
5	Retyped and revised per suggestion		11-2-92
PIPING DESIGN AND TEST REQUIREMENTS		GAS TRANSMISSION	
		DOCUMENT NUMBER - PAGE 087950 5	



Converted to Interleaf
GTR0119064

- 6. The date the recorder was last calibrated and serial number of the dead weight tester or other reference standard used.
- H. The above information is to be recorded on the chart at the time of the test. After the test is completed, the supervisor is to review the chart and then sign and date it to verify that it complies with the requirements of this standard.
- I. The original of the test chart is to be attached to the original of the Strength Test Pressure Report Form 62-4921. 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.

12. Appendixes

- A. Piping Data Sheet - Design and Test Requirements

- B. Piping Data Sheet - API 5L Grades B and A-25
- C. Piping Data Sheet - API 5L Grade X-42
- D. Piping Data Sheet - API 5L Grade X-52
- E. Piping Data Sheet - API 5L Grade X-60
- F. Piping Data Sheet - API 5L Grade X-65
- G. Plain End Pipe Minimum Wall Thickness
- H. Emergency Pipe Test Information Form
- I. Requirements for Pipeline Plan and Profile Construction Drawings
- J. Required Information for Pipeline Construction Drawings
- K. Transmittal Form.

REV.	DESCRIPTION	APPROVED BY	DATE
5	Retyped and revised per suggestion		11-2-92
 PIPING DESIGN AND TEST REQUIREMENTS		GAS TRANSMISSION	
		DOCUMENT NUMBER - PAGE 087950 6	

Converted to Interleaf