Prepared by: [redacted]

PIPING DESIGN AND TEST REQUIREMENTS

A-34

Department:	Gas System Maintenance and Technical Support	**Section:** System Integrity	**Date:** 12-09-03
Approved by:	E. G. Kirkpatrick	**Approved by:** [redacted]	

Rev. #03: This document replaces Revision #02. For a description of the changes, see Page 7.

Purpose and Scope

This gas standard establishes a uniform procedure for designing and testing gas piping systems that will meet the requirements of 49 CFR, Part 192.

Acronyms

ASTM:	American Society for Testing and Materials
CFR:	*Code of Federal Regulations*
CGT:	California Gas Transmission
CPUC:	California Public Utilities Commission
DOT:	Department of Transportation
DP:	design pressure
DWT:	dead weight tester
ERW:	electric resistance welded
G.O.:	General Order
GSM&TS:	Gas System Maintenance and Technical Support
MAOP:	maximum allowable operating pressure
MOP:	maximum operating pressure
OD:	outside diameter
psi:	pounds per square inch
psig:	pounds per square inch gauge
SMYS:	specified minimum yield strength

References

Document

Gas Standards and Specifications

Pipeline Dimensions and Properties	A-10
Dimensions and Properties	A-10.1
Identification of Steel Pipe	A-11
Code Numbers for Steel Pipe	A-15
General Requirements Work Reportable to the California Public Utilities Commission	A-34.1
Design and Construction Requirements – Gas Lines and Related Facilities.	A-36
Plastic Gas Distribution System Construction and Maintenance	A-93.1
Steel Butt-Welding Fittings	B-20
Arc Welding Procedure Requirement – All Stress Levels	D-22
Weld Inspection	D-40
Names of Pipe Coatings for Use on Pipeline Survey Sheets and Other Records	E-10
Electrolysis Test Station Connection to Main	O-10

UO Standards

CPUC and DOT Reportable Incidents, Curtailments and Conditions and Low Pressure System Problem Reporting	D-S0355/S4413
Maximum Allowable Operating Pressure, Requirements for Distribution Systems and Transmission and Gathering Lines	D-S0430/S4125
Selection of Steel Gas Pipeline Repair Methods	S4134

CGT Standards

Class Location Determination, Compliance, and Maintenance	4127

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Piping Design and Test Requirements

Note

CPUC G.O. 112E, Section 125, requires written and verbal notification of certain work. See Gas Standard A-34.1 for these requirements.

Definitions

The following definitions shall apply to this gas standard:

1. "Class Location" is a geographic area as classified and described in 49 CFR 192 and CGT Standard 4127.
2. "Design Factor" is the percentage of SMYS to which operating stress is limited, as further described in 49 CFR 192.
3. "DP" is the maximum operating pressure permitted by regulation as determined by design procedures. Design pressure depends on the pipe's size, wall thickness, composition material, and proposed location.
4. "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 medium in the pipe.
5. "Leak Test" is a pressure test to determine the tightness of the system.
6. "MAOP" is the maximum pressure at which a gas pipeline, pipeline segment, or component is qualified to operate according to the requirements of 49 CFR 192.
7. "MOP" is the maximum pressure at which a system may be operated according to the criteria established in UO Standard D-S0430/S4125.
8. "SMYS" is the minimum yield strength in psi prescribed by the specification under which the pipe is purchased from the manufacturer or as specified in 49 CFR 192.
9. "Strength Test" is a pressure test to prove the mechanical strength of the system.
10. "Stress" is the resultant internal force per unit area that opposes change in the size or shape of a body that is acted on by external forces.
11. "Test Medium" is a substance such as water, air, or gas used to exert an internal pressure to leak or strength test a facility.
12. "Test Pressure" is the pressure of the medium specified for testing.

General Information

1. Filing Information

   Revision 03 supersedes any previous instructions which are contrary to the content of this gas standard.

2. Policy and Application

   All new and reconstructed gas piping systems and facilities are to be designed and tested according to the requirements of 49 CFR 192. This includes abandoned or temporarily disconnected piping that is reinstated.

3. Responsibility

   A. The responsible engineer shall prepare a "Gas Pipeline Facilities Strength Test Pressure Report" (see Attachment F) for each facility designed to support a MAOP of 100 psig or greater. The engineer shall ensure that all applicable information is completed in "Part 1 – Design Data." These reports shall accompany the construction documents to the field.

   B. The supervisor responsible for the facility's construction shall ensure it is tested according to this gas standard. Before testing any facility designed to support a MAOP of 100 psig or greater, the supervisor shall verify that a "Gas Pipeline Facilities Strength Test Pressure Report," with "Part I – Design Data" completely filled out and signed, is available at the jobsite. The supervisor shall also verify that the pipe specifications and footages are correct before proceeding with the test. After finishing the test, the supervisor shall complete "Part II - Test Data."

   C. The engineer and the construction supervisor are responsible for ensuring that all other applicable provisions of 49 CFR 192 are followed when designing, constructing, and testing a facility.

4. Design

   A. A design criteria stamp (see Figure 1 on Page 4) shall be completed for each size, specification, grade, seam-type, and wall thickness of pipe shown on Plan and Profile/Sections sheets. A separate design criteria

[redacted]

stamp is required for each MAOP to be established and for each test pressure. The DP and MAOP to be specified on the design criteria stamp are for the pipe segment to be tested.

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

(1) Future development of the area.

(2) Current and future gas supply pressures.

(3) Probability of increases in supply pressure.

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

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

Where: P = maximum allowable design pressure, psig
S = SMYS, psi
t = nominal wall thickness, inches
D = outside diameter, inches
F = design factor determined according to 49 CFR 192.111
E = longitudinal joint factor determined according to 49 CFR 192.113
T = temperature derating factor determined according to 49 CFR 192.115

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

E. 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, as a minimum, the planned future MAOP requirements of the pipeline. Attachments B and C of this gas standard contain specifications for commercially available pipe commonly used at PG&E. Other sizes and wall thicknesses are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

F. Requirements for Pipeline Construction Drawings

Attachment D and Attachment E provide the content, format, technical, and professional engineering review requirements for pipeline plan and profile construction drawings.

5. Inspection

A. Welds shall be inspected as required by Gas Standard D-40.

B. Girth welds used to tie in fabricated units and short sections of pipe shall be inspected as required by Gas Standard D-40.

C. Trenches, pipe, and pipe coating shall be inspected as required by Gas Standard A-36.

6. Testing

A. All new, replaced, or reconnected pipelines and facilities transporting natural gas shall be tested according to the requirements in this gas standard. Except as documented in Notes 2 and 3 to Table A-1 in Attachment A on Page 9, the test shall be conducted after the pipeline and/or facilities have been installed.

B. The test medium shall be one permitted by Note 6 to Table A-1 in Attachment A on Page 9. Factors to be considered when choosing a test media shall include safety, availability, and economy.

C. The test pressure shall not be less than that required by Attachment A to test the tightness and strength of a system. All lines shall be tested according to Attachment A.

D. Pipe held for emergency use shall be tested as specified in Attachment A.

E. Pipelines should be tested as required to support a MAOP equal to the design pressure. Testing to support only a lower MAOP is acceptable, but an additional test or uprating will be required to justify any subsequent increases in the MAOP.

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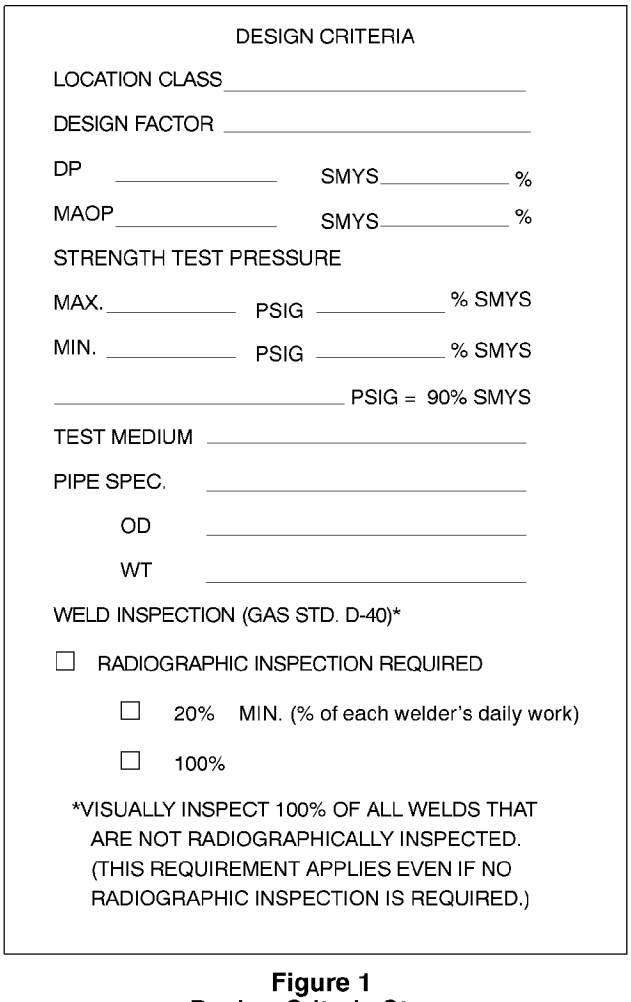
Piping Design and Test Requirements



See Item 4A on Page 2

Figure 1
Design Criteria Stamp

F. Facilities Damaged by Construction Work

(1) All facilities known or suspected to have been struck during excavation or construction activities shall be checked to ensure 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 ensure that leaks are not present.

(a) Repairs to damaged steel transmission or distribution lines shall be made according to UO Standard S4134.

(b) Repairs to damaged plastic mains shall be made according to Gas Standard A-93.1.

(c) Special attention shall be given to a damaged casing for a plastic insert. Ensure 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 if the casing for a metallic insert has been broken, bent, pulled, crushed, or otherwise deformed, the service shall be tested from tee to riser according to Attachment A.

[redacted]

(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.

(c) See Gas Standard A-93.1 for a description of approved plastic lines and plastic inserts, and for information on testing plastic service risers which may have been exposed to excessive heat.

(d) All service risers that have been struck and/or damaged in aboveground 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.

G. Instrument Lines

Although testing instrument piping is not explicitly required by regulation, it is a prudent engineering practice to test all buried instrument piping that is subjected directly to mainline gas pressures. Buried instrument piping shall be tested according to the applicable test requirements in Table A-1. It is not necessary to test tubing, but all fittings and connections should be checked for leaks after start-up.

H. Branch Connections and Fittings

(1) For installation of a hot tap branch connection with reinforcement pad or sleeve, the branch-to-header weld shall be leak tested for a minimum of 5 minutes before installing the reinforcement pad or sleeve. The minimum test pressure shall be 100 psig. The maximum test pressure shall be 110 psig.

(2) When installing line stopper fittings, the fitting shall be leak tested for a minimum of 5 minutes after it has been completely welded to the pipe and before tapping. The minimum test pressure shall be 100 psig. The maximum test pressure shall be 110 psig.

I. Service-Line Connection (Other Than Plastic)

If feasible, the service-line connection to the main must be included in the leak test with the service line. If this is not feasible, it must be given a leakage test at the operating pressure when placed in service.

7. 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. 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:

(1) The pressure to which the valve was tested by the manufacturer,

(2) The age and condition of the valve, and

(3) 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 the required MAOP of the line cannot be established because of this limitation, the responsible operating department shall determine 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, with prior approval from the responsible operating department, closed valves may be subjected to a hydrostatic test pressure exceeding their maximum working pressure. Approval will depend on the type and condition of the valve, and will only be given with the limitations that (1) the differential pressure not exceed the working pressure and (2) the test pressure not exceed the manufacturer's shell test pressure.

D. When practical, mainline valve assemblies shall be tested separately from pipeline construction to prevent damage to the valves during the initial pipeline pigging. The separate valve assembly test shall be followed by a 100 psig leak test of the valve seats before welding the assembly in the pipeline.

8. Records

A. Facilities Designed to Operate at 100 psig or Greater

(1) Estimate 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 required information shall be supplied for each size and type.

(2) A "Gas Pipeline Facilities Strength Test Pressure Report" (see Attachment G) is required for each facility being tested to support a MAOP of 100 psig or greater (see Attachment A).

(3) If the line is to have a MAOP equivalent to 30% of SMYS or greater, a test chart is required (see Item 9, "Test Chart").

(4) If any portion of a line is tested to over 90% SMYS, a 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 "Gas Pipeline Facilities 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) "Job Estimate," Form 62-6251, shall be marked by the person preparing the estimate to indicate if the pipe must be strength tested.

B. Facilities Designed to Operate at Less Than 100 psig

For facilities designed to operate at less than 100 psig, test information shall be recorded on the "Gas Service Record" form, on the estimate sketch, and on the work order or other authorized form.

C. For systems being uprated, it is required to complete a test chart according to Item 9.

D. All required test records shall be retained by the responsible operating department for the useful life of the facility.

9. Test Chart

A chart record shall be made of the pressure test on all upratings and on pipelines being tested to support a MAOP equivalent to 30% of SMYS or greater. The procedure for handling the chart, and the minimum information required on the chart, are described below:

A. The chart shall be designed for the recorder on which it is to be used and shall have appropriate scale and time lines.

B. The recorder should have been calibrated no more than 6 months before the date of the test. The recorder's calibration records shall be checked before conducting the test.

C. The chart shall be set on the correct time at the start of the test. The actual time, date, and initials of the person starting the test shall be written on the face of the chart at the start of the test.

D. The chart shall document a minimum of 8 hours of testing (except where a 4-hour test is permitted in Attachment A). Any discrepancies shall be explained.

E. At the end of the test, the actual time, date, and initials of the person removing the chart shall be written on the face of the chart.

F. The section of pipe being tested shall be identified on the face of the chart, along with the job number.

G. The following information shall be recorded on the back of the chart at the time of the test.

(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) serial number of the recorder or other means of identification.

(6) date the recorder was last calibrated and serial number of the DWT or other reference standard used.

H. After the test is completed, the supervisor shall review the chart, and then sign and date it to verify that it complies with the requirements of this gas standard.

I. The original test chart shall be attached to the original of the "Gas Pipeline Facilities Strength Test Pressure Report," Form 62-4921. A copy of the test chart shall be attached to each copy of the "Gas Pipeline Facilities Strength Test Pressure Report." This record shall be retained for the life of the facility.

[redacted]

Attachments

Attachment A . . . . Test Requirements
Attachment B . . . Steel Pipe Specifications - (API) 5L Grades B, A-25, X-42, X-52, X-60, X-65
Attachment C . . . Minimum Wall Thickness for Fabricated Assemblies and Stations
Attachment D . . . Requirements for Pipeline Plan and Profile/Section Construction Drawings
Attachment E . . . Required Information for Pipeline Construction Drawings
Attachment F . . . . Instructions for the Gas Pipeline Facilities Strength Test Pressure Report
Attachment G . . . Gas Pipeline Facilities Strength Test Pressure Report
Attachment H . . . Emergency Pipe Test Information Form

Revision Notes

Revision 03 has the following changes:

1. Changed the referenced standard in Item 6F(2)(a) on Page 4.
2. Added Item 6I on Page 5.
3. Revised all the appendixes to attachments.
4. Revised Note 11 on Page 10 in Attachment A.
5. Revised the "Gas Pipeline Facilities Strength Test Pressure Report" and the "Emergency Pipe Test Information Form." These forms are now standalone, separate MS Word documents.
6. Changed the sequence of the attachments so MS Word files are at the end.
7. This document is part of Change 53.

[redacted]

Attachment A – Test Requirements

Table A-1 Test Requirements for Pipelines, Mains, Services, Instrument Lines, and Other Gas Facilities

Proposed MAOP		Plastic (See Note 1 on Page 9)	Steel				
			Less Than or Equal to 60 psig (Including Low Pressure)	Over 60 and Less Than 100 psig	Under 30% SMYS and at or Above 100 psig	30% SMYS or More	Pretested Pipe for Emergency Use (See Note 3 on Page 9)
Component to be Tested		Pipelines, Mains, Services, Fabricated Units, and Short Sections of Pipe				Pipeline, Fabricated Units, Short Sections of Pipe	
Type of Test		Leak	Leak	Leak	Strength	Strength	Strength
Test Medium (See Note 4 on Page 9)		Air or Gas (See Note 5 on Page 9)			Water, Air, Inert Gas, or Gas (See Notes 5, 6, and 7 on Page 9)		Water
Maximum Test Pressure (See Notes 6 and 7 on Page 9)		150 psig	110 psig	300 psig	(See Notes 8 and 9 on Page 9)	100% SMYS or Factory Test Pressure of Fitting (See Notes 8 and 10 on Pages 9 and 10)	100% SMYS
Minimum Test Pressure		100 psig or 1.5 x MAOP Whichever is Greater	100 psig (See Note 11 on Page 10)	1.5 x MAOP	1.5 x Design Pressure (See Note 12 on Page 10)	1.5 x Design Pressure (See Notes 10 and 12 on Page 10)	90% SMYS Recommended
Duration of Test		5 Minutes (See Note 2 on Page 9 and Note 13, for Plastic, on Page 10)			1 Hour Minimum (See Note 2 on Page 9 and Note 14 on Page 10)	8 Hours Minimum (See Note 2 on Page 9 and Note 14 on Page 10)	4 Hours Minimum
Test Records Required (See Note 15 on Page 10)	Forms Required	Complete Box on Job Estimate Form or Gas Service Record Form			Completed Strength Test Pressure Report		
	Test Chart	No (See Note 16 on Page 10)			No (See Note 16 on Page 10)	Yes (See Note 17 on Page 10)	

[redacted]

Attachment A, continued

Notes

1. The temperature of thermoplastic material shall not be more than 100°F, or the temperature at which the material's long-term hydrostatic strength has been determined under ASTM D 2513, whichever is greater.
2. Pre-Installation Tests
   A. For fabricated units and short sections of pipe for which a post-installation test is impractical, a pre-installation test may be substituted. The pre-installation test shall be conducted whenever possible at the jobsite and shall comply with the pressure requirements for a post-installation test. If the test cannot be conducted at the jobsite, the pipe shall be visually inspected before installation to ensure that it has not been damaged during transit to the jobsite. A fabricated unit is defined as an assembly of one or more fittings with pipe, equipment with pipe, or pieces of pipe joined together. Examples include, but are not limited to, mainline valve assemblies, branch connections, and tie-in pieces.
   B. For fabricated units or short sections that will have a MAOP at or above 30% SMYS, the pre-installation test shall be a minimum of 4 hours.
3. Testing Emergency Stock Pipe
   A. The following blocks in Part 1 of the "Gas Pipeline Facilities Strength Test Pressure Report" should not be completed for emergency pipe since it is not known at the time of the test where the pipe will be installed: "Location Class," "Design Factor," "MAOP of Existing Facilities," "MAOP to Be Established by This Test," "Design Pressure – This Section (Use Future Design Pressure whenever possible,)" and "% of SMYS at Design Pressure."
   B. It is recommended that all emergency pipe be tested to a minimum of 90% of SMYS for a minimum of 4 hours.
   C. The Emergency Pipe Test Information form (see Attachment H) shall be completed after the strength test and attached to the "Gas Pipeline Facilities Strength Test Pressure Report."

   For emergency repairs, some exceptions to the design and test requirements may be permitted, but only with the approval of the GSM&TS Pipeline Engineering section.
4. All tests to over 50% of SMYS should be performed with water as the test medium, unless such a test is impractical. Where a hydrostatic test is impractical, air or inert gas may be used, with the limitations shown in Note 6 on Page 9. When a test using air or inert gas is being performed, buildings within 300 feet of the test section must be evacuated.
5. Testing using water, air, or inert gas is not normally permitted where the test section is isolated from an operating line by only a closed valve, squeeze-off equipment, or plugging equipment. This is because a leak may occur, creating an undesirable and potentially hazardous situation. If the test must be performed under these conditions, obtain approval from a GSM&TS Pipeline Engineer (see Attachment D, Note 7, Professional Engineering Review). Additional precautions may be required in order to minimize the possibility of an accident. For test limitations on valves, see Item 7 on Page 5.
6. Maximum test pressure permitted, expressed as a percent of SMYS.

Class Location	1	2	3	4
Air or Inert Gas (See Note 4 on Page 9)	80	75	50	40
Natural Gas	80	30	30	30
Water	100	100	100	100

7. Safety – When testing with air, inert gas, or natural gas, the pressure shall be held at about 100 psig and observed for leakage before raising to the required test pressure.
8. Maximum test capabilities of fittings (i.e., valves and elbows) must be determined before testing (see Item 7 on Page 5).
9. For facilities operating at or under 30% of SMYS and at or above 100 psig, the maximum test pressure shall be determined by the responsible engineer. A reasonable differential between maximum and minimum test pressures should be allowed, considering elevation differentials and the requirements of Note 8 above.

[redacted]

Attachment A, continued

10. Testing Pipelines and Station Piping
    A. All pipelines 6" and larger, designed to operate at more than 40% of SMYS, shall be tested to a minimum of 90% of SMYS, and as close to 100% of SMYS as practical. (Tests of ERW pipe should be limited to a maximum of 95% of SMYS.) This will permit them to continue to operate at an established MAOP should a class location change occur. Do not use a test to 90% of SMYS as an alternative to designing a pipeline to meet a higher class location which may reasonably be anticipated to occur in the future.
    B. For pipelines 6" and larger, which are designed to operate at over 20% of SMYS and up to 40% of SMYS, consideration should be given to test to a minimum of 90% of SMYS. Testing to this pressure will provide additional assurance of the integrity of the line and will minimize the possibility of a failure due to stress resulting from soil settlement or other environmental effects. The decision to conduct a test to the higher pressure should be based on engineering judgment, and take into account:
        (1) The importance of the line to meet system demand, and
        (2) Any potential environmental effects on the line as might be caused by intense development or heavy construction near the line.
    C. It is often not practical to test station piping to 90% of SMYS because of limitations of valves, flanges, and other devices. In these cases, the station will not be able to continue to operate after a class location change that results in a design factor lower than the required minimum 0.5 design factor for stations. Therefore, it is extremely important that the station be designed for the lowest design factor that might occur during the life of the station. If an area is anticipated to change in the near future to Class 4, use a 0.4 design factor so the station can continue to operate after the change.
11. Cut, test, and transferred services in low pressure distribution systems that will remain low pressure shall be leak tested to 10 psig for pipelines other than plastic, or 50 psig or 1.5 times minimum operating pressure, whichever is greater for plastic pipelines. These include:
    A. Services which must be extended with new pipe in order to tie into the new main, and
    B. Repaired services (i.e., services with segments that have been repaired or replaced with new pipe).
12. The minimum test pressure shall not be less than 1.5 times the design pressure in Class 2, 3, and 4 locations, and not less than 1.25 times the design pressure in a Class 1 location. The only exception is for transmission lines where testing to 1.5 times the design pressure creates problems due to limitations imposed by valves (see Note 8) and where the future MAOP to be established is below the design pressure. The minimum test pressure may then be limited to 1.5 times the MAOP, with the approval of the GSM&TS Pipeline Engineering section (see Attachment D, Note 7, Professional Engineering Review).
13. Although the test duration for plastic pipe is 5 minutes, it is desirable to maintain the test pressure for a longer period of time if the construction schedule permits. If the pipe is not gassed up on the same day as the test, it shall be retested before gassing up.
14. Where pipelines are installed on street or highway bridges under permits from governmental agencies, more stringent testing may be required by the agency than would be required by this gas standard. For pipelines with a MAOP over 200 psig located on California state bridges, the test pressure shall be maintained for a minimum of 24 hours.
15. All records that document leak and strength tests shall be retained for the life of the facility.
16. Table A-1 on Page 8 indicates test chart requirements for new facilities. Test charts are required for all upratings regardless of the operating pressure of the line.
17. Test charts shall be completed and retained as outlined in Item 9 on Page 6.

[redacted]

Attachment B – Steel Pipe Specifications

Notes

1. The symbols and abbreviations used in the tables in this attachment refer to the following:

   API – American Petroleum Institute

   DSAW – Double Submerged Arc Welded

   ERW – Electric Resistance Welded

   SMYS – Specified Minimum Yield Strength

   20%, 30%, etc. means % of SMYS.

2. A-25 and X-42 are the most economical choices for most applications through 10".

   Grade B is normally used when seamless pipe is required.

   X-52, X-60, and X-65 become desirable as diameters and operating pressures increase.

3. Other combinations of size, grade, and wall thickness are available.

   GSM&TS should be consulted if a pipe that is not shown is to be used or if there is a question as to the most economical grade or wall thickness for a particular application.

4. "Standard Wall" pipe (see Gas Standards A-10 and A-10.1) is the minimum allowable wall thickness for bridge crossings. Minimum allowable wall thicknesses for pipe sizes 2" through 8" for use in gathering systems are indicated in Table B-1, Table B-2, and Table B-4 of this attachment. Minimum allowable wall thickness for fabricated assemblies and stations are indicated in Attachment C. Consult the GSM&TS Pipeline Engineering section if further information is required.

5. When specifying pipe, the following information shall be given in sequence:

   A. Outside diameter and wall thickness.

   B. API specification and grade.

   C. Longitudinal seam welding process.

   D. Coating: Specify bare or coated. If coated, the type of coating for each installation must be recorded in the permanent records (see Gas Standard E-10).

   E. PG&E code number. (See Gas Standard A-15).

6. Examples

   A. Typical coated pipe specification for either orders or records:

      16" OD x 0.250 WT

      API 5L Grade X-42, ERW, Wrapped

      Code 011286

   B. Typical bare pipe specification for either orders or records:

      4.50" OD x 0.237 WT

      API 5L Grade B, Seamless

      Code 011693

[redacted]

Attachment B, continued

Table B-1 Steel Pipe Specification - API 5L Grade B Seamless, 35,000 psi SMYS

Nominal Pipe Size (Inches)	Outside Diameter [3, 4] (Inches)	Wall Thickness [3, 4] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
3/4 [1]	1.05	0.113	7,534	6,780	5,424	4,520	3,767	3,014	2,260	1,507
1-1/4 [1]	1.66	0.140	5,904	5,314	4,251	3,543	2,952	2,362	1,772	1,181
2 [1, 2]	2.375	0.154	4,539	4,086	3,269	2,724	2,270	1,816	1,362	908
3 [1]	3.5	0.216	4,320	3,888	3,111	2,592	2,160	1,728	1,296	864
4 [1]	4.5	0.237	3,687	3,318	2,655	2,212	1,844	1,475	1,106	738
6 [1]	6.625	0.280	2,959	2,663	2,131	1,776	1,480	1,184	888	592
8 [1]	8.625	0.322	2,614	2,352	1,882	1,568	1,307	1,046	784	523
10	10.75	0.365	2,377	2,140	1,712	1,427	1,189	951	714	476
12	12.75	0.375	2,059	1,853	1,483	1,236	1,030	824	618	412
16	16.0	0.375	1,641	1,477	1,182	985	821	657	493	329
20	20.0	0.375	1,313	1,182	945	788	657	525	394	263
24	24.0	0.375	1,094	985	788	657	547	438	329	219

[1] Pipe normally in stock. For codes, see Gas Standard A-15.
[2] Pipe is the minimum allowable grade and wall thickness for use in gas field gathering systems with a MAOP of 800 psig or less.
[3] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[4] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

Table B-2 Steel Pipe Specification - API 5L Grade B ERW, 35,000 psi SMYS

Nominal Pipe Size (Inches)	Outside Diameter [3, 4] (Inches)	Wall Thickness [3, 4] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
3 [1, 2]	3.5	0.156	3,120	2,808	2,247	1,872	1,560	1,248	936	624
4 [1, 2]	4.5	0.156	2,427	2,184	1,748	1,456	1,214	971	728	486
6	6.625	0.219	2,314	2,083	1,667	1,389	1,157	926	695	463
8	8.625	0.219	1,778	1,600	1,280	1,067	889	711	534	356
10	10.75	0.219	1,427	1,284	1,027	856	714	571	428	286
12	12.75	0.219	1,203	1,083	866	722	602	481	361	241
14	14.0	0.250	1,250	1,125	900	750	625	500	375	250
16	16.0	0.250	1,094	985	788	657	547	438	329	219

[1] Pipe normally in stock. For codes, see Gas Standard A-15.
[2] Pipe is the minimum allowable grade and wall thickness for use in gas field gathering systems with a MAOP of 800 psig or less.
[3] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[4] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

[redacted]

Attachment B, continued

Table B-3 Steel Pipe Specification – API 5L Grade A-25, Furnace Butt Weld [2], 25,000 psi SMYS

Nominal Pipe Size (Inches)	Outside Diameter [3, 4] (Inches)	Wall Thickness [3, 4] (Inches)	(Company's Operating Limit for A-25 Pipe is 400 psig)	Pressure at % of SMYS (psig)
3/4 [1]	1.05	0.113	–	>400
1-1/4 [1]	1.66	0.140	–	>400
2 [1]	2.375	0.154	–	389

[1] Pipe normally in stock. For codes, see Gas Standard A-15.
[2] Butt weld pipe has 0.6 joint factor. However, for pipe specified in this table, calculated pressures exceed the 400 psig Company limit.
[3] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[4] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

Table B-4 Steel Pipe Specification – API 5L Grade X-42, 6"–18" ERW, 16"–42" DSAW, 42,000 SMYS

Nominal Pipe Size (Inches)	Outside Diameter [3, 4] (Inches)	Wall Thickness [3, 4] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
6	6.625	0.156 [1, 2]	1,978	1,781	1,425	1,187	989	792	594	396
		0.172	2,181	1,963	1,571	1,309	1,091	873	655	437
		0.188 [1]	2,384	2,146	1,717	1,431	1,192	954	716	477
8	8.625	0.172 [2]	1,676	1,508	1,207	1,006	838	671	503	336
		0.188 [1]	1,831	1,648	1,319	1,099	916	733	550	367
		0.219 [1]	2,133	1,920	1,536	1,280	1,067	854	640	427
10	10.75	0.219	1,712	1,541	1,233	1,027	856	685	514	343
		0.250 [1]	1,954	1,759	1,407	1,173	977	782	587	391
		0.281	2,196	1,977	1,581	1,318	1,098	878	659	440
		0.365	2,853	2,567	2,054	1,712	1,427	1,141	856	571
12	12.75	0.219	1,443	1,299	1,039	866	722	578	433	289
		0.250	1,648	1,483	1,186	989	824	659	495	330
		0.281 [1]	1,852	1,667	1,333	1,111	926	741	556	371
		0.375 [1]	2,471	2,224	1,779	1,483	1,236	989	742	495
16	16.0	0.250	1,313	1,182	945	788	657	525	394	263
		0.281	1,476	1,328	1,063	886	738	591	443	296
		0.375 [1]	1,969	1,772	1,418	1,182	985	788	591	394
18	18.0	0.250	1,167	1,050	840	700	584	467	350	234
		0.312	1,456	1,311	1,049	874	728	583	437	292
20	20.0	0.250	1,050	945	756	630	525	420	315	210
		0.281	1,181	1,063	850	709	591	473	355	237
		0.312	1,310	1,180	944	787	656	525	394	263
		0.344	1,445	1,301	1,041	867	723	578	434	289
		0.375	1,575	1,418	1,134	945	788	630	473	315

[1] Pipe normally in stock. For codes, see Gas Standard A-15.
[2] Pipe is the minimum allowable grade and wall thickness for use in gas field gathering systems with MAOP of 800 psig or less. Refer to Gas Standard B-20 for thin wall fittings suitable for welding to this pipe.
[3] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[4] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

[redacted]

Attachment B, *continued*

Table B-4 Steel Pipe Specification – API 5L Grade X-42, 6"–18" ERW, 16"–42" DSAW, 42,000 SMYS, continued

Nominal Pipe Size (Inches)	Outside Diameter [1, 2] (Inches)	Wall Thickness [1, 2] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
22	22.0	0.250	955	860	688	573	478	382	287	191
		0.312	1,192	1,073	858	715	596	477	358	239
24	24.0	0.250	875	788	630	525	438	350	263	175
		0.281	984	886	709	591	492	394	296	197
		0.312	1,092	983	787	656	546	437	328	219
		0.344	1,204	1,084	867	723	602	482	362	241
		0.375	1,313	1,182	945	788	657	525	394	263
26	26.0	0.281	908	818	654	545	454	364	273	182
		0.312	1,008	908	726	605	504	404	303	202
		0.344	1,112	1,001	801	667	556	445	334	223
30	30.0	0.406	1,137	1,024	819	683	569	455	342	228
		0.438	1,227	1,104	884	736	614	491	368	246
		0.469	1,314	1,182	946	788	657	526	394	263
32	32.0	0.469	1,232	1,109	887	739	616	493	370	247
		0.500	1,313	1,182	945	788	657	525	394	263
		0.562	1,476	1,328	1,063	886	738	591	443	296
34	34.0	0.469	1,159	1,043	835	696	580	464	348	232
		0.500	1,236	1,112	890	742	618	495	371	248
		0.562	1,389	1,250	1,000	834	695	556	417	278
36	36.0	0.500	1,167	1,050	840	700	584	467	350	234
		0.562	1,312	1,181	945	787	656	525	394	263
		0.625	1,459	1,313	1,050	875	730	584	438	292
40	40.0	0.562	1,181	1,063	850	709	600	473	355	237
		0.625	1,313	1,182	945	788	657	525	394	263
		0.688	1,445	1,301	1,041	867	723	578	434	289
42	42.0	0.562	1,124	1,012	810	675	562	450	338	225
		0.625	1,250	1,125	900	750	625	500	375	250
		0.688	1,376	1,239	991	826	688	551	413	276

[1] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[2] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

[redacted]

Attachment B, *continued*

Table B-5 Steel Pipe Specification – API 5L Grade X-52, 10"–18" ERW, 16"–42" DSAW, 52,000 SMYS

Nominal Pipe Size (Inches)	Outside Diameter [2, 3] (Inches)	Wall Thickness [2, 3] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
10	10.750	0.219	2,119	1,907	1,526	1,272	1,060	848	636	424
12	12.750	0.219	1,787	1,608	1,287	1,072	894	715	536	358
		0.250	2,040	1,836	1,469	1224	1,020	816	612	408
		0.250	1,625	1,463	1,170	975	813	650	488	325
16	16.0	0.281	1,827	1,644	1,316	1,096	914	731	548	366
		0.312	2,028	1,826	1,461	1,217	1,014	812	609	406
18	18.0	0.250	1,445	1,300	1,040	867	723	578	434	289
20	20.0	0.250	1,300	1,170	936	780	650	520	390	260
		0.281	1,462	1,316	1,053	877	731	585	439	293
		0.312	1,623	1,461	1,169	974	812	649	487	325
		0.344	1,789	1,610	1,288	1,074	895	716	537	358
		0.375 [1]	1,950	1,755	1,404	1,170	975	780	585	390
		0.406	2,112	1,901	1,521	1267	1,056	845	634	423
22	22.0	0.250	1,182	1,064	851	710	591	473	355	237
24	24.0	0.250	1,084	975	780	650	542	434	325	217
		0.281	1,218	1,096	877	731	609	488	366	244
		0.312	1,352	1,217	974	812	676	541	406	271
		0.344	1,491	1,342	1,074	895	746	597	448	299
		0.375	1,625	1,463	1,170	975	813	650	488	325
		0.438	1,898	1,709	1,367	1,139	949	760	570	380
26	26.0	0.281	1,124	1,012	810	675	562	450	338	225
		0.312	1,248	1,124	899	749	624	500	375	250
		0.344	1,376	1,239	991	826	688	551	413	276
		0.375	1,500	1,350	1,080	900	750	600	450	300

[1] Pipe normally in stock. For codes, see Gas Standard A-15.
[2] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[3] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

[redacted] [redacted]

Attachment B, *continued*

Table B-5 Steel Pipe Specification – API 5L Grade X-52, 10"–18" ERW, 16"–42" DSAW, 52,000 SMYS, continued

Nominal Pipe Size (Inches)	Outside Diameter [1, 2] (Inches)	Wall Thickness [1, 2] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
30	30.0	0.375	1,300	1,170	934	780	650	520	390	260
		0.406	1,408	1,267	1,014	845	704	563	423	282
		0.438	1,519	1,367	1,091	912	760	608	456	304
32	32.0	0.406	1,320	1,188	950	792	660	528	396	264
		0.438	1,424	1,282	1,028	855	712	570	428	285
		0.469	1,525	1,372	1,097	915	763	610	458	305
		0.500	1,625	1,463	1,170	975	813	650	488	325
34	34.0	0.438	1,340	1,206	965	804	670	536	402	268
		0.469	1,435	1,292	1,033	861	718	574	431	287
		0.500	1,530	1,377	1,102	918	765	612	459	306
36	36.0	0.438	1,266	1,139	912	760	633	507	380	254
		0.469	1,355	1,220	976	813	678	542	407	271
		0.500	1,445	1,300	1,040	867	723	578	434	289
40	40.0	0.500	1,300	1,170	936	780	650	520	390	260
		0.562	1,462	1,316	1,053	877	731	585	439	293
		0.625	1,625	1,463	1,170	975	813	650	488	325
42	42.0	0.500	1,239	1,115	892	743	620	496	372	248
		0.562	1,392	1,253	1,002	835	696	557	418	279
		0.625	1,548	1,393	1,115	929	774	620	465	310

[1] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[2] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

[redacted]

Attachment B, *continued*

Table B-6 Steel Pipe Specification – API 5L Grade X-60, 20"–42" DSAW, 60,000 SMYS

Nominal Pipe Size (Inches)	Outside Diameter [2, 3] (Inches)	Wall Thickness [2, 3] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
20	20.0	0.250	1,500	1,350	1,080	900	750	600	450	300
		0.281	1,686	1,518	1,214	1,012	843	675	506	338
		0.312	1,872	1,685	1,348	1,124	936	749	562	375
		0.375	2,250	2,025	1,620	1,350	1,125	900	675	450
22	22.0	0.250	1,364	1,228	982	819	682	546	410	273
24	24.0	0.250	1,250	1,125	900	750	625	500	375	250
		0.281	1,405	1,265	1,012	843	703	562	422	281
		0.312 [1]	1,560	1,404	1,124	936	780	624	468	312
		0.375	1,875	1,688	1,350	1,125	938	750	563	375
		0.406	2,030	1,827	1,462	1,218	1,015	812	609	406
26	26.0	0.281	1,297	1,168	934	779	649	519	390	260
		0.312	1,440	1,296	1,037	864	720	576	432	288
		0.344	1,588	1,429	1,144	953	794	636	477	318
		0.375	1,731	1,558	1,247	1,039	866	693	520	347
		0.406	1,874	1,687	1,350	1,125	937	750	563	375
30	30.0	0.375	1,500	1,350	1,080	900	750	600	450	300
		0.406	1,624	1,462	1,170	975	812	650	488	325
		0.438	1,752	1,577	1,262	1,052	876	701	526	351
32	32.0	0.375	1,407	1,266	1,013	844	704	563	422	282
		0.406	1,523	1,371	1,097	914	762	609	457	305
		0.438	1,643	1,479	1,183	986	822	657	493	329
34	34.0	0.406	1,433	1,290	1,032	860	716	574	430	287
		0.438	1,546	1,392	1,114	928	773	619	464	310
		0.469	1,656	1,490	1,192	994	823	663	497	332
		0.500	1,765	1,589	1,271	1,059	882	706	530	353
36	36.0	0.406	1,354	1,218	975	812	677	542	406	271
		0.438	1,460	1,314	1,052	876	730	584	438	292
		0.469	1,564	1,407	1,126	938	782	626	469	313
		0.500	1,667	1,500	1,200	1,000	834	667	500	334
40	40.0	0.438	1,314	1,183	947	789	657	526	395	263
		0.469	1,407	1,267	1,014	845	704	563	423	282
		0.500	1,500	1,350	1,080	900	750	600	450	300
42	42.0	0.469	1,340	1,206	965	804	670	536	402	268
		0.500	1,429	1,286	1,029	858	715	572	429	286
		0.562	1,606	1,446	1,157	964	803	643	482	322

[1] Pipe normally in stock. For codes, see Gas Standard A-15.
[2] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[3] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

[redacted]

Attachment B, *continued*

Table B-7 Steel Pipe Specification – API 5L Grade X-65, 34"–42" DSAW, 65,000 SMYS

Nominal Pipe Size (Inches)	Outside Diameter [1, 2] (Inches)	Wall Thickness [1, 2] (Inches)	Pressure at % of SMYS (psig)							
			Class Location:		1	2	3	4		
			100%	**90%**	**72%**	**60%**	**50%**	**40%**	**30%**	**20%**
34	34.0	0.375	1,434	1,291	1,033	861	717	574	431	287
		0.406	1,553	1,398	1,118	932	777	621	466	311
		0.438	1,675	1,508	1,206	1,005	838	670	503	335
36	36.0	0.406	1,467	1,320	1,056	880	734	587	440	294
		0.438	1,582	1,424	1,139	949	791	633	475	317
		0.469	1,694	1,525	1,220	1,017	847	678	509	339
		0.500	1,806	1,625	1,300	1,084	903	723	542	362
40	40.0	0.438	1,424	1,282	1,025	855	712	570	428	285
		0.469	1,525	1,372	1,098	915	763	610	458	305
		0.500	1,625	1,463	1,170	975	813	650	488	325
42	42.0	0.469	1,452	1,307	1,046	871	726	581	436	291
		0.500	1,548	1,393	1,115	929	774	620	465	310
		0.562	1740	1,566	1,253	1,044	870	696	522	348

[1] In the design formula for steel pipe, these correspond to outside diameter (D) and nominal wall thickness (t).
[2] Other sizes and wall thickness are available from pipe manufacturers. Consult the GSM&TS Pipeline Engineering section for assistance.

[redacted]

Attachment C – Minimum Wall Thickness for Fabricated Assemblies and Stations

Table C-1 Plain End Pipe Minimum Wall Thickness

Nominal Pipe Size (Inches)	Outside Diameter (Inches)	Minimum Wall Thickness
3/4	1.050	0.113 (Grade B)
1	1.315	0.133 (Grade B)
1-1/4	1.660	0.140 (Grade B)
2	2.375	0.154 (Grade B)
3	3.5	0.216 (Grade B)
4	4.5	0.237 (Grade B)
6	6.625	0.280 (Grade B)
8	8.625	0.322 (Grade B)
10	10.750	0.365 (Grade B)
12	12.750	0.375 (Grade B)
14	14.0	0.375 (Grade B)
16	16.0	0.375 (Grade B)
18	18.0	0.375 (Grade B)
20	20.0	0.375 (Grade B)
22	22.0	0.375 (Grade B)
24	24.0	0.375 (Grade B)
26	26.0	0.375 (Grade B)
30	30.0	0.375 (Grade B)
32	32.0	0.375 (Grade B)
34	34.0	0.375 (Grade B)
36	36.0	0.500 (Grade B)
40	40.0	0.500 (Grade B)
42	42.0	0.500 (Grade B)

Notes

1. For fabricated assemblies/compressor stations (above ground piping), the minimum Grade B material with standard or extra strong wall thickness is based on compatibility with standard and extra heavy wall fittings. Extra strong pipe should be used for all screwed connections through a 2" nominal diameter.
2. Extra strong pipe through a 2" nominal diameter is recommended for compressor stations because of the potential fatigue failure problems due to vibration.

[redacted]

Attachment D – Requirements for Pipeline Plan and Profile/Section Construction Drawings

Purpose and Scope

1. This attachment establishes formatting and review requirements for pipeline drawings. Similar requirements for station drawings are being drafted for inclusion into this gas standard at a later date.
2. Any gas pipeline work that is reportable to the CPUC (Section 125 of G.O. 112) must have construction drawings that show the plan and profile.
3. In addition, because CPUC G.O. 112 requirements are a minimum criteria and plan and profile/sections drawings demonstrate good pipeline engineering practice, plan and profile/sections drawings shall be used for pipeline work on the following critical lines (even if the work is not reportable under Section 125):
   - All numbered transmission pipelines.
   - Distribution Feeder Mains (DFMs) that operate at or greater than 20% of SMYS.
   - Any critical lines that operate over 60 psig and have elevation variations.

Drawing Format

4. The requirement for pipeline construction drawings can be met by using the existing 3- or 4-size plan and profile construction drawing format. For small projects or simple offsets to clean underground structures, the requirement can be met by using a sections and details drawing format.

Technical Review

5. Any gas pipeline work that is reportable to the CPUC must have a technical review by a qualified engineer as designated by the manager responsible for the facilities.
6. In addition to the CPUC-reportable projects, it is recommended that drawings for pipeline sections that are more than 100' in length or 12" in diameter or larger, and are to be installed on bridges, also be submitted for technical review before being issued for bids or construction.

Professional Engineering Review

7. There is currently no legal requirement for pipeline construction drawings (other than civil and structural drawings) to be stamped by a licensed professional engineer. However, it is current practice to stamp new construction drawings for gas facilities. To emphasize professional engineering reviews and focus accountability, all pipeline plan and profile/section drawings for work on pipelines with a design pressure or future design pressure greater than 60 psig must be reviewed and stamped by a professional engineer. The engineer (civil or mechanical) must be currently registered in the state of California and competent in pipeline engineering as designated by the manager responsible for the facilities.

[redacted]

Attachment E – Required Information for Pipeline Construction Drawings

Purpose and Scope

1. This attachment provides guidelines for preparing and reviewing pipeline construction drawings.

Plan and Profile/Sections

2. In plan view, show the dimensions from the pipeline to fixed, aboveground structures and/or the property line. Show ETSs and all applicable details in the Reference Details section. Show the right-of-way and all substructures. Clearly identify new, existing, or to-be-abandoned gas lines.
3. In profile view, or a section detail, identify significant offsets and the approximate dimensions to substructures which require the offsets. Show the stationing for survey details.
4. Specify the minimum depth of cover.
5. In the Pipeline Details Stationing section, show the stations for all pipeline details, including tie-ins, substructures, valves, elbows, transition points (changes in pipe wall thickness, SMYS, coating, etc.), and ETSs. Indicate all applicable details (tie-ins, ETSs, etc.) shown in the Reference Details section.

Bill(s) of Material

6. A bill(s) of material is required for all pipeline drawings. The Bill of Materials section must include a complete description of all items. Include all PG&E code numbers and reference drawings or gas standards.
   A. Pipe – Indicate the size, wall thickness, longitudinal seam type, grade, and specification to which the pipe is to be manufactured. Also, identify the type of coating (and joint tape).
   B. Fittings – Indicate the size, wall thickness, special end preparation, material, and grade of pipe to be used. Also, include the specification to which the fitting is to be manufactured.
   C. Valves – Indicate the type of valve (ball, plug, gate, etc.), size, pressure rating, type of end connections, type and configuration of operator (gearing or lever or automatically operated) with dimensions, wall thickness of weld ends (if applicable), and the serial number.
   D. Taps – Indicate the type of reinforcement including grade, wall thickness, size, and the specification of plate material to be used. Refer to the appropriate gas standard for construction information on either the cold branch or hot tap.
   E. Sleeves – Indicate the size, wall thickness, grade, and the specification of the plate material to be used. Also, specify backup strips and the appropriate gas standard containing information on installing and fabricating the sleeve.
   F. Casings – Indicate the size, wall thickness, and grade. Also, specify the gas standard containing information on casings and the approved vent material. Specify the appropriate insulators and end seals.
   G. Pipeline Markers – Specify the type and the gas standard containing information on pipeline markers.
   H. Cathodic Protection – Specify the type and location and the gas standard containing information on cathodic protection. If an insulating fitting is to be installed, specify the manufacturer, size, and type of end connections (e.g., wall thickness, grade, and specification of the pipe to which the fitting is to be welded). If pipe flanges, insulating gaskets, and insulating kits for bolts are to be used, be sure to specify the pressure rating, size, and bore of flanges, the size and number of bolts required, and the size and number of insulating kits required.

Reference Details Section

7. Tie-in details
   A. Include the diameter, wall thickness, grade, seam, and specification of new pipe and the existing pipe to which the new pipe is to be tied. Do not make a tie-in at a fitting or a valve. Also, because stresses due to pipe expansion and contraction tend to be concentrated at elbows, if the new pipe is to be tied to existing pipe having a thinner wall thickness, and the tie-in point is near an existing thin wall elbow or an elbow fabricated from sections of mitered pipe, the design should be changed to replace the existing elbow with one matching the strength of the new pipe.

[redacted]

Attachment E, continued

B. At the tie-in location, if there is a wall thickness difference greater than 3/32", or a pipe yield strength difference between the new and existing pipe, show the applicable weld detail from Gas Standard D-22 on the drawing. In every case, an attempt shall be made to attain an acceptable butt-welded joint. However, if misalignment of carrier pipes or other problems preclude any reasonable possibility of obtaining an acceptable butt-welded joint, use a sleeve. A single-split sleeve is preferred over the double-split sleeve for this purpose.

8. Welding details – Show wall thickness changes greater than 3/32" between adjoining pipe components. Include detail at each change in the line pipe. Line pipe-to-fitting detail can be typical.
9. Trench details – Include a typical trench detail indicating minimum cover, back fill material, and minimum trench width.
10. Crossing details – Include railroad and highway crossings, and all casings and vents. Also, show locations of vent risers.
11. Cathodic protection details – Include a detail for each type of cathodic protection station and reference Gas Standard O-10. For Type E stations, show the dimension between the connection points.

Miscellaneous Requirements

12. Use design criteria stamps for each size, specification, grade, seam type, wall thickness, and location class of pipe shown on specific plan and profile/sections sheets. A separate design criteria stamp is required for each MAOP and for each test pressure.
13. Use a welding requirements stamp.
14. Testing requirements – Include the time, duration of the test, and the maximum and minimum pressures recorded during tests. Fill out a "Strength Test Pressure Report" for each hydro test performed.
15. Signatures of approving parties – Drawings must be signed by the manager responsible for the facility or his or her designated representative.
16. Include the following notes on each sheet:
    A. "All field bends are smooth field bends, except where elbows are noted. Field bends shall be made according to Gas Standard A-36, Item 4D."
    B. "This pipeline must be installed with at least 12" of clearance from any other underground structure not associated with the pipeline."
17. List any reference drawings pertinent to the installation of the piping shown on the plan and profile sections of the drawing.
18. Indicate mile posts at the beginning and end of the project. Also, include the mile post (or stationing) of any taps or valves being installed.
19. Special notes – Indicate additional information if CPUC notification is required. Also, indicate if it is required to notify local agencies and PG&E employees before starting work. Indicate any special construction conditions imposed by the CPUC, local agencies, or PG&E.
20. When hot tapping is required, indicate the maximum pressure allowed in the pipeline during welding and tapping operations.
21. All pipeline plan and profile/sections construction drawings for pipeline work with a design pressure or future design pressure greater than 60 psig shall be reviewed, signed, and stamped by a professional engineer. The engineer (mechanical or civil) must be currently registered in the state of California and competent in pipeline engineering as designated by the manager responsible for the facilities.

[redacted]

Attachment F – Instructions for the Gas Pipeline Facilities Strength Test Pressure Report

Purpose and Scope

This attachment provides instructions for completing the "Gas Pipeline Facilities Strength Test Pressure Report," Form 62-4921.

General

1. **Maintain a test record for the life of the facility.** For all strength tests, and for leak tests performed on facilities operating at greater than 100 psig, make the test record on the "Gas Pipeline Facilities Strength Test Pressure Report." Where geographical conditions, such as mountainous terrain, make it necessary to divide the pipeline being tested into two or more test sections, use a separate form for each test section.

Explanation of Form Entries

2. Part I – Design Data

   A. Description of Job: Provide a brief description of the pipe to be tested, including pipe size, pipe length, pipe location, and reference construction drawing number.

   B. Location Class: Determine the location class as described in 49 CFR 192.5.

   C. Design Factor: Determine the design factor as described in 49 CFR 192.111.

   D. MAOP of Existing Facilities (psig): Show the present MAOP of any existing pipeline facilities involved with the test or construction project as established according to the applicable provisions of 49 CFR 192. Where the test involves extending, paralleling, replacing, or uprating an existing pipeline facility, show the MAOP of that facility. If the test covers an entirely new facility, write "none" in the space.

   E. MAOP to Be Established For This Section by This Test: This test will establish the MAOP according to the requirements of UO Standard D-S0430/S4125. The test shall be conducted according to the requirements of this gas standard. The MAOP may equal but shall never exceed the future design pressure. For pipelines that operate at or over 20% of SMYS, this is the MAOP recorded in PG&E Drawing No. 086868.

   F. Design Pressure — This Section: This is the Future Design Pressure recorded in PG&E Drawing No. 086868. Use when designing all future additions, modifications, or replacement of a facility. All materials and equipment installed in the facility shall be designed and installed so that they may qualify for a MAOP equal to the design pressure, according to the applicable requirements of 49 CFR 192. Under certain circumstances, the design pressure may be greater than the MAOP to be established for the segment involved.

   G. Static Head Due to Elevation Difference: When a line is installed through an area where there are appreciable differences in elevation, make an allowance for the static head due to the weight of the test fluid used for the hydrostatic test. When determining the test pressure for a section of line, ensure that the test pressure at the highest elevation point in the line is above the minimum test pressure specified in Table A-1 of Attachment A. Also ensure that the test pressure at the lowest elevation point in the test section does not exceed the maximum test pressure specified in Table A-1 of Attachment A. At no point along the line shall the test pressure be greater than the pressure which produces a stress level equal to the yield strength of the pipe being tested.

   H. Static Head Calculation: To obtain the hydrostatic test pressure difference in the line due to the difference in elevation, multiply the difference in elevation (in feet) between the highest point and the lowest point in the test section by 0.433 psi/foot, if the test fluid is water. This will give the pressure differential in psi due to the static head:

$$0.433\ \frac{psi}{ft} \times (difference\ in\ elev.)\ ft\ =\ (pressure\ differential)\ psi$$

   If using a test fluid other than water, make a correction for the difference in specific gravities. Consult the Pipeline Engineering section of the GSM&TS department for assistance.

   I. Verified in Field: Pipe OD, wall thickness, specification, and footage must be verified by the person supervising the test. The supervisor shall indicate this verification is complete by initialing the space provided beside the information.

[redacted]

Attachment F, continued

J. % of SMYS: Obtained from the hoop stress equation. Let stress at any given pressure P_1 be denoted by S_1.

$$Then, \quad S_1 = \frac{P_1 D}{2t}$$

$$by\ definition, \ \%\ SMYS\ @\ P_1 = \frac{S_1}{SMYS} \times 100$$

$$Therefore, \ \%\ SMYS\ @\ P_1 \ \frac{P_1 D}{2t(SMYS)} \times 100$$

Substitute the design pressure, minimum test pressure, and maximum test pressure in the equation as P_1 to obtain their corresponding % of SMYS.

Note

For some older pipe, a longitudinal joint factor must be included when performing the calculations (see Gas Standard A-11). A temperature derating factor must also be used if the gas temperature exceeds 250°F (see 49 CFR 192.115). Contact the Pipeline Engineering section when either of these conditions occur.

K. Pressure to give 90% of SMYS:

$$from, \ P = \frac{2St}{D}$$

$$P\ @\ 90\%\ SMYS = \frac{2(0.9)\ (SMYS)\ (t)}{D} = \frac{1.8\ (SMYS)\ (t)}{D}$$

L. Minimum Test Pressure

(1) Testing New Facilities: See Attachment A Note 5 on Page 9. In some situations, the test pressure may be reduced as allowed by Attachment A Note 4. Where an elevation difference exists, the minimum test pressure will be at the maximum elevation.

Note

The static head due to elevation difference must not cause the pressure at the lowest point in the test section to exceed the pressure which produces a stress level equal to the yield strength of the pipe being tested.

(2) Uprating Existing Facilities: When an uprating is to occur by taking the pipeline, main, or segment out of service and performing a strength test, the facility must be successfully tested as described in this gas standard; specifically to the requirements applicable for a new line of the same material in the same location. Prepare and complete a strength test pressure report for the work performed.

M. Maximum Test Pressure: The test pressure for any pipeline shall not be greater than the pressure which produces a hoop stress of 100% of SMYS of the pipe, regardless of the strength of the valves, regulators, and similar equipment. If the MAOP of the pipeline cannot be established without exceeding the rated pressure of the equipment, consult the Pipeline Engineering section. Where an elevation difference exists, the maximum test pressure will occur at the lowest elevation point in the test section.

If the minimum test pressure is substantially less than the pressure which produces 100% of SMYS, an arbitrary maximum may be established which is close to, but higher than, the minimum test pressure. The difference should be sufficient to permit variations in the test pressure due to elevation, temperature changes during the test, minor leaks, or equipment problems or limitations. A 200 psi differential should normally be adequate.

N. Minimum Test Duration: Facilities being tested which are designed to operate at under 30% of SMYS must be tested for a minimum of 1 hour. If they are to operate at or over 30% of SMYS, they must be tested for a minimum of 8 hours.

Note

Conduct a pre-installation strength test for fabricated units and short sections of pipe scheduled to operate at or over 30% of SMYS, for which a post-installation test is impractical. Conduct the test by maintaining the pressure at or above the test pressure for a minimum of 4 hours. Refer to Attachment A Note 6 on Page 9.

O. The person preparing the "Gas Pipeline Facilities Strength Test Pressure Report" **and** the person approving the report are **both** required to sign it.

[redacted]

Attachment F, continued

3. Part II – Test Data

   A. Any changes brought about by unexpected field conditions from the requirements specified in Part I of the test report must be approved by the person preparing Part I of the report.

   B. Actual Duration of Test: Testing must never take less time than that specified in Part I and must be continuous for the required time period. Any drop of test pressure below the required minimum test pressure represents a termination of the test. The facility must be retested for the **entire** required time period. Be certain that the duration of the test is documented on the form and test chart, including the starting and stopping times.

      It may be desirable to maintain the test pressure for a few minutes longer than the minimum required in Part I. This could avoid questions concerning chart or timing errors.

   C. Elevation at Test Point: Note the mile post (location) and ground elevation of the point where the test pressure gauge(s) is to be installed. If the test pressure gauge(s) is not installed at the minimum or maximum elevation in the test section, adjust the information in the spaces provided for "Minimum Test Pressure" and "Maximum Test Pressure" accordingly.

   D. Min. Indicated Test Pressure: This is the actual test pressure indicated on the pressure gauge(s) at the test point. If the pressure varies during the test, the lowest pressure during the period shall be the indicated test pressure. To ensure an acceptable test, the test pressure should be held a few psi above the minimum to prove that minor fluctuations do not drop the pressure below minimum. This would require restarting the test period.

   E. Min. Test Pressure at Max. Elevation: This is the minimum pressure in the test section and is determined as described below:

      (1) When the test pressure is recorded at the highest elevation in the test section, the indicated test pressure is the "Min. Test Pressure at Max. Elevation."

      (2) When the test pressure is taken at a point other than the highest elevation in the test section, the indicated test pressure **less** the static head due to the elevation difference between the test point and the highest elevation, is the "Min. Test Pressure at Max. Elevation."

      The pressure at the highest elevation in the test section must be greater than or equal to the pressure stated for "Minimum Test Pressure," as indicated in Part I – Design Data.

   F. Max. Test Pressure at Min. Elevation: This is the maximum pressure in the test section and is determined as described below:

      (1) When the test pressure is recorded at the lowest elevation in the test section, the indicated test pressure is the "Max. Test Pressure at Min. Elevation."

      (2) When the test pressure is recorded at a point other than the lowest elevation in the test section, the indicated test pressure **plus** the static head due to the elevation difference between the test point and the lowest elevation, is the "Max. Test Pressure at Min. Elevation."

      The pressure at the lowest elevation in the test section must not exceed the pressure stated for "Maximum Test Pressure," as indicated in Part I – Design Data.

   G. Test Fluid Used: Indicate whether water, air, gas, inert gas, or some other fluid is used as the test medium.

   H. Pipe Specification and Footage Verified: Pipe specification and footage must be verified by the person supervising the test (see Part I).

   I. The information on the test gauge and/or dead weight tester used during the test must be recorded, including the instrument's last calibration date. See Item 9 on Page 6 for the test chart requirements.

   J. The person supervising the test and the person approving the test report must sign the report. Signatures should be completed in the field at the time of the test. Signatures should **not** be entered by a clerk at a later date.

[redacted]

Attachment F, continued

K. Schematic Piping Sketch – It is necessary to provide the following information on the schematic sketch:

(1) The location of the facility tested.

(2) The minimum and maximum elevation (in feet).

(3) Mile points or engineering stations, valve numbers, and incorporated areas.

(4) Piping, equipment, fittings, etc., included in the test section.

(5) If additional space is required, use the back of the form or another sheet. Be sure that the job number and any reference numbers are shown on the face of all attachments.

(6) If the person preparing the Strength Test Pressure Report included a sketch, the sketch must be verified in the field and corrected as necessary to represent the actual test setup. The sketch should also include information on the job number and the time and date of the test.

L. Any failure when strength testing a pipeline to be operated at a hoop stress of 20% or more of SMYS shall be reported within 2 hours of the failure as required by UO Standard D-S0355/S4413. A written report is required for all test failures.

[redacted]