

	<h2 style="margin: 0;">STEEL PIPE MATERIAL SPECIFICATION</h2>	<h2 style="margin: 0;">A-16</h2>
Asset Type: Gas Transmission and Distribution		Function: Design
Issued by: [REDACTED]		Date: 03-24-08
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Rev. #01: This document replaces Revision #00. For a description of the changes, see Page 5.		

Purpose and Scope

This numbered document provides the required specifications for all steel pipe purchased for use in the Company's natural gas piping systems. It includes the required specifications for the types, grades, and sizes of line pipe listed in Table 1 below.

Table 1 Steel Pipe Included in This Document

Type	Grade	Nominal OD (Inches)
SMLS	B to X-52	0.75 to 16.000
DSAW	X-42 to X-70	20.000 and larger
ERW	B to X-60	2.375 to 20.000

Acronyms

- API: American Petroleum Institute
- ASNT: American Society of Non-Destructive Testing
- CE: carbon equivalent
- DSAW: double-submerged arc-welded
- ERW: electric resistance weld
- ID: inside diameter
- NDE: non-destructive examination
- OD: outside diameter
- psi: pounds per square inch
- SMLS: seamless
- SMYS: specified minimum yield strength
- SQ: Supplier Quality

Conditions of Acceptance

1. General Requirements
 - A. Mill-run, furnished pipe shall meet the product specification Level 2 (PSL 2) requirements of API-5L (43rd edition and errata, 2004), this numbered document, and the PG&E Purchase Order, unless otherwise specified in writing by the Company.
 - B. If mill-run, furnished pipe is not available, distributors' stock pipe that meets the requirements of API-5L (43rd edition and errata 2004) and the PG&E Purchase Order will be accepted as an alternative, unless otherwise specified in writing by the Company.
 - C. Material properties, such as high ductility, that are required by this numbered document are essential for the intended use of the pipe included in this document. Any deviations will be cause for rejection.
 - D. Pipe manufactured as Grade X-65 or higher shall not be substituted for pipe ordered as Grade X-60 or lower without PG&E's prior written approval.

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- E. The supplier shall furnish bare pipe with no loose mill scale, foreign matter, or oil. The pipe may have mill-applied lacquer coating if it is being furnished from stock.
- F. The pipe ends shall be cut square within a tolerance of 1/16".
 - (1) The ends of 1-1/2" and smaller diameter pipe shall be tapered for socket welding.
 - (2) The ends of 2 inch and larger diameter pipe shall be beveled for welding.
- G. Pipe of 1-1/2" and smaller diameter shall be in single random lengths with a minimum average length of 20', a minimum length of 17', and a maximum length of 23'. Pipe of 2" and larger diameter shall be in double random lengths with a minimum average length of 38', a minimum length of 34', and a maximum length of 40'. Triple random lengths will be permitted for 16" and larger pipe.
- H. No joiners shall be included in any pipe that is the subject of a PG&E Purchase Order.

2. Chemical Properties and Test Requirements

- A. The following requirements apply to all pipe purchased.
 - (1) The supplier shall provide PG&E with heat, product, and mill control analyses. The test reports shall describe the results of the tests and demonstrate compliance with the respective chemical property requirements of API-5L.
 - (2) The following elements and the percentages of each found in the pipe shall be included in the mill test reports: C, Mn, Cr, Al, Ni, Cu, Mo, Nb, V, Ti, P, S, and Si.
 - (3) Pipe shall be manufactured from fully-killed steel with low sulfur content (<0.01%) to enhance its energy absorption capabilities. Steel shall be fully killed with silicon (Si) and/or aluminum (Al).
 - (4) If the skelp is to be center split, the phosphorus (P) content shall be < 0.015%, unless C < 0.07%.
 - (5) The CE of the material, as determined by heat analysis, shall be calculated according to the following formula.

$$CE = C + \frac{(Mn)}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

- (6) The carbon equivalent shall be as low as possible, and never exceed the maximum allowable value of 0.40%. The actual value for each heat shall be provided on the mill test reports.
- B. The following requirement applies to ERW pipe purchased only from a mill run.

Product samples from the same heat shall be taken from lengths made from different coils. If the samples must come from the same coil, one sample shall be taken from the middle and the other from one end of the coil.

3. Mechanical Properties and Test Requirements

- A. The following requirement applies to all pipe purchased.

The supplier shall provide PG&E with reports documenting all mechanical tests specified by API-5L. The test reports shall describe the results of each mechanical test and demonstrate compliance with the respective mechanical requirements of API-5L and this numbered document.
- B. The following requirements do not apply to pipe purchased from stock.
 - (1) For each heat of steel used to manufacture pipe, the supplier shall provide PG&E with the results of the fracture toughness tests per API-5L, SR5A, and SR5B. All test specimens shall be Charpy V-notch, Type A, 2/3 size. The minimum wall for transverse Charpy specimens shall be 0.250 inch. The test temperature shall be 32°F. For 2/3-size specimens (longitudinal and transverse), the Charpy V-notch energy values shall meet the requirements of Table 2 on Page 3. If the wall thickness will not allow 2/3-size specimens, reduced-size specimens are acceptable. Full size test specimens will be allowed on a case-by-case basis. Flattening of specimens will also be allowed. If full-size or reduced-size specimens are used, the acceptable V-notch energy values shall be proportional to the values shown in Table 2 on Page 3 (the ratio of the specimen size to the 2/3-size specimen). The test report shall describe the test results and demonstrate compliance with the requirements of API-5L, SR5A, SR5B, SR19, and this numbered document.
 - (2) In addition to Item 3.B.(1) above, the supplier shall provide PG&E with the results of weld Charpy impact tests per API-5L, SR5A, and SR5B. Standard test specimens shall be Charpy V-notch, Type A, 2/3-sized, and be taken transverse to and across the weld seam. The test temperature shall be 32°F. For 2/3-sized

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specimens, the Charpy V-notch energy values shall meet the requirements of Table 2 below. If the wall thickness will not allow 2/3-sized specimens, reduced-sized specimens are acceptable. Flattening of specimens is allowed. If full-sized or reduced-sized specimens are used, the acceptable V-notch energy values shall be proportional to Table 2 below (per ratio of the specimen size to the 2/3-sized specimen). The test report shall describe the test results and demonstrate compliance with the requirements of API-5L, SR5B, SR19, and the values in this numbered document.

Table 2 Minimum Absorbed Energy for Charpy Test of Type A, 2/3 Size Specimens

Grade	Minimum Average Energy (Foot-Pounds)	Minimum Individual Energy (Foot-Pounds)
X-65 and X-70	40	33
B to X-60	30	25

- (3) For tensile testing, the minimum elongation in 2" shall be greater than or equal to 30% for Grades X-60 and lower, and 25% or greater for Grades X-65 and X-70.

4. Inspection Requirements

A. The following requirements do not apply to pipe purchased from stock.

- (1) The supplier shall arrange for inspection at least one week before the start of production by contacting PG&E SQ.

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- (2) The designated PG&E SQ inspector shall witness the necessary tests and review all of the required material test reports after they have been prepared by the supplier. The supplier shall pay all return freight charges if the pipe is delivered, but PG&E determines in its sole discretion, that the pipe fails to meet the requirements of this numbered document.

B. The following requirement applies only to pipe purchased from stock.

The supplier shall arrange for inspection at least one week before shipment by contacting PG&E SQ. The judgment of PG&E's SQ inspector is final regarding the supplier's handling and storage of the pipe, or regarding pipe quality issues. If the inspector deems it necessary to inspect the full surface of the pipe, the supplier shall provide sufficient space to spread out the pipe and roll it so the entire surface can be viewed.

5. Manufacturing Process Requirements (ERW Pipe Only)

- A. The minimum temperature for the post-weld heat treatment of the weld seam shall be 1,700°F.
B. The temperature shall be monitored and continuously recorded.

6. Hydrostatic Testing Requirements

- A. The requirements of this entire section do not apply to pipe purchased from stock.
B. If distortion or bowing occurs at the required test pressure, the test pressure may be reduced in 100 psi increments until the distortion or bowing disappears, but in no case shall the hydrostatic test pressure be reduced below the standard test pressure specified by API-5L.
C. For all hydrostatic tests, the test pressure shall be held for a minimum of 10 seconds.
D. For seamed pipe, the weld seam shall be facing up and observed throughout the application of the test pressure.

7. Non-destructive Examination Requirements

- A. The requirements of this entire section do not apply to pipe purchased from stock.
B. All NDE acceptance tests for a length of pipe shall be performed **after** the cold expansion (if used) and the final hydrostatic testing for that length have been successfully completed.
C. All pipe mills producing line pipe for PG&E in compliance with API-5L and this numbered document shall establish a written document outlining the control and administration of NDE personnel training, examination, and certification. This document shall also describe the responsibility of NDE personnel certified at each level

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(Levels I, II, and III) regarding the determination of the acceptability of pipe welds and pipe body material, in accordance with the applicable codes and this numbered document.

- D. Certification of all levels of NDE personnel is the responsibility of the supplier. A supplier who purchases outside services is responsible for ensuring that any purchased training and examination services are in accordance with the supplier's written practices and with this numbered document.
- E. All NDE tests shall be performed by personnel qualified to at least Level I and shall be supervised by a Level II or Level III inspector in accordance with the ASNT Recommended Practice SNT-TC-1A or its equivalent. Any indications that are judged by a Level I inspector to be irrelevant shall be reviewed by a Level II or III inspector.
- F. The calibration standard for seam inspection shall consist of OD and ID N10 notches and at least three 1/8" or 1/16" diameter drilled holes. The holes shall be at least 10" apart, and one of the holes shall be on the weld centerline. The other two holes shall have their centers offset from each side of the weld centerline by at least 1/8".
- G. All in-line testing equipment shall be calibrated at the line speed to be used during testing, and the artificial defects described in Item 7E shall activate alarm circuits when passing the sensors at line speed.
- H. If the NDE acceptance test used is the automated ultrasonic testing with stationary probes, then the test arrangement shall use multiple probes and simultaneously test both sides of the weld seam. Other NDE test methods approved by API-5L and the PG&E SQ inspector may also be used for acceptance tests.
- I. Pipe that fails to pass a properly-calibrated automated NDE shall not be applied to the PG&E Purchase Order, unless the method for retesting and the results of the retesting are approved by the PG&E SQ inspector.

8. Defect Repair

- A. The judgment of the PG&E SQ inspector is final when determining if an irregularity in the pipe constitutes an injurious defect, and whether pipe with such injurious defects may be repaired, downgraded, or not applied to the PG&E Purchase Order.
- B. Any defects found in the body of the pipe shall not be repaired by welding.
- C. Defects found in the weld seam may be repaired within the following limits:
 - (1) Repairs are only allowed before hydrotesting and expansion.
 - (2) Only one repair per location is allowed.
 - (3) The minimum repair length is 2".
 - (4) The maximum repair length is 12".
 - (5) No repairs are allowed within 12" of either end of a joint of pipe.
 - (6) The minimum distance between repairs is equal to half of the OD of the pipe.
 - (7) The maximum number of repairs per joint of pipe is two.
 - (8) The maximum number of joints of pipe in one order that can be repaired is 2% of the number of joints of pipe in that order.
- D. Dents shall not be repaired by hammering or jacking on the pipe.
- E. Land faces shall not be filed. Burrs shall be removed from the inside diameter by filing, provided the land face is not affected. Damaged pipe ends shall be removed as a cylinder, if necessary, and re-beveled beyond the damaged area.

9. Marking Requirements

- A. All pipes shall be marked according to API-5L Appendix I. In addition, the PG&E Purchase Order number and the heat number shall be **legibly** paint-stenciled by the supplier inside one end of each length of pipe. The PG&E Purchase Order number can be written by hand only if it is legibly written with a permanent marker (e.g., Nissen or equivalent).
- B. PG&E may require the re-marking of illegibly-labeled pipe lengths and may reject any length that it considers to be untraceable.

10. Shipping Requirements

All pipe shall be handled, stored, and transported in accordance with the requirements of PG&E [Gas Engineering Material Specification 4113](#), "[Specifications for Handling, Storage and Transporting of Bare and Coated Pipe](#)."

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Revision Notes

Revision 01 has the following changes:

1. Revised the grade range for ERW and nominal OD range for DSAW and ERW in Table 1 on Page 1.
2. Deleted the "General Information" section.
3. Specified the edition of API-5L in Item 1A of the "Conditions of Acceptance" section on Page 1.
4. Added an entire Item 8C on Page 4.
5. Performed minor language revisions.
6. This document is part of Change 60.