Specification for Line Pipe

API SPECIFICATION 5L
FORTY-FIFTH EDITION, DECEMBER 2012

EFFECTIVE DATE: JULY 1, 2013
Specification for Line Pipe

Upstream Segment

API SPECIFICATION 5L
FORTY-FIFTH EDITION, DECEMBER 2012

EFFECTIVE DATE: JULY 1, 2013
Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

Classified areas may vary depending on the location, conditions, equipment, and substances involved in any given situation. Users of this specification should consult with the appropriate authorities having jurisdiction.

Users of this specification should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.
Foreword

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Shall: As used in a standard, “shall” denotes a minimum requirement in order to conform to the specification.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the specification.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 1220 L Street, NW, Washington, DC 20005.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.
## Contents

1. **Scope** ................................................................................................................................. 1
2.  Conformity ................................................................................................................................. 1
   2.1 Units of measurement ........................................................................................................... 1
   2.2 Rounding ............................................................................................................................... 1
   2.3 Compliance to this Standard ................................................................................................. 1
3.  Normative references ................................................................................................................. 2
4.  Terms and definitions ................................................................................................................. 5
5.  Symbols and abbreviated terms ................................................................................................. 13
   5.1 Symbols .................................................................................................................................. 13
   5.2 Abbreviated terms .................................................................................................................. 14
6.  Pipe grade, steel grade and delivery condition .......................................................................... 15
   6.1 Pipe grade and steel grade .................................................................................................... 15
   6.2 Delivery condition .................................................................................................................. 16
7.  Information to be supplied by the purchaser .......................................................................... 17
   7.1 General information ............................................................................................................. 17
   7.2 Additional information .......................................................................................................... 18
8.  Manufacturing ............................................................................................................................ 21
   8.1 Process of manufacture ......................................................................................................... 21
   8.2 Processes requiring validation ............................................................................................... 23
   8.3 Starting material .................................................................................................................... 23
   8.4 Tack welds ............................................................................................................................ 24
   8.5 Weld seams in COW pipe ..................................................................................................... 25
   8.6 Weld seams in SAW pipe ...................................................................................................... 25
   8.7 Weld seams in double-seam pipe .......................................................................................... 25
   8.8 Treatment of weld seams in EW and LW pipes .................................................................... 25
   8.9 Cold sizing and cold expansion ........................................................................................... 25
   8.10 Coil/plate end welds ............................................................................................................ 26
   8.11 Jointers ............................................................................................................................... 26
   8.12 Heat treatment ..................................................................................................................... 26
   8.13 Traceability .......................................................................................................................... 26
9.  Acceptance criteria ..................................................................................................................... 27
   9.1 General .................................................................................................................................... 27
   9.2 Chemical composition ........................................................................................................... 27
   9.3 Tensile properties .................................................................................................................. 31
   9.4 Hydrostatic test ..................................................................................................................... 32
   9.5 Bend test .................................................................................................................................. 33
   9.6 Flattening test ....................................................................................................................... 33
   9.7 Guided-bend test ................................................................................................................... 34
   9.8 CVN impact test for PSL 2 pipe ............................................................................................... 34
   9.9 DWT test for PSL 2 welded pipe ........................................................................................... 36
   9.10 Surface conditions, imperfections and defects ..................................................................... 36
   9.11 Dimensions, mass and tolerances ......................................................................................... 38
   9.12 Finish of pipe ends .............................................................................................................. 43
   9.13 Tolerances for the weld seam .............................................................................................. 45
   9.14 Tolerances for mass ............................................................................................................ 48
   9.15 Weldability of PSL 2 pipe ..................................................................................................... 48
10. Inspection ................................................................................................................................. 49
10.1 Types of inspection and inspection documents ................................................................. 49
10.2 Specific inspection ................................................................................................................. 50
11 Marking ........................................................................................................................................ 78
11.1 General .................................................................................................................................. 78
11.2 Pipe markings ......................................................................................................................... 78
11.3 Coupling markings ................................................................................................................... 81
11.4 Marking of pipe to multiple grades ....................................................................................... 81
11.5 Thread identification and certification ................................................................................. 81
11.6 Pipe processor markings ....................................................................................................... 82
12 Coatings and thread protectors ............................................................................................... 82
12.1 Coatings and linings ................................................................................................................. 82
12.2 Thread protectors ..................................................................................................................... 82
13 Retention of records .................................................................................................................. 82
14 Pipe loading ............................................................................................................................... 83
Annex A (normative) Specification for welded jointers ............................................................... 84
Annex B (normative) Manufacturing procedure qualification for PSL 2 pipe ......................... 85
Annex C (normative) Treatment of surface imperfections and defects ..................................... 90
Annex D (normative) Repair welding procedure ....................................................................... 92
Annex E (normative) Non-destructive inspection for other than sour service or offshore service ................................................................................................................................. 99
Annex F (normative) Requirements for couplings (PSL 1 only) .................................................. 112
Annex G (normative) PSL 2 pipe with resistance to ductile fracture propagation .................. 115
Annex H (normative) PSL 2 pipe ordered for sour service .......................................................... 122
Annex I (normative) Pipe ordered as “Through the Flowline” (TFL) pipe ................................. 135
Annex J (normative) PSL 2 pipe ordered for offshore service ....................................................... 137
Annex K (normative) Non-destructive inspection for pipe ordered for sour service and/or offshore service ................................................................................................................................. 153
Annex L (informative) Steel designations ..................................................................................... 158
Annex M [Removed] ....................................................................................................................... 161
Annex N (informative) Identification/explanation of deviations ................................................ 162
Annex O (informative) Use of the API Monogram by Licensees ................................................ 163
Annex P (informative) Equations for Threaded and Coupled Pipe and Background Equations for Guided Bend and CVN Test Specimens ................................................................................ 168
Bibliography .................................................................................................................................. 179
Introduction

This Standard is based on API Spec 5L, 44th Edition.

In the preparation of this document, the technical committee maintained the concept of two basic levels of standard technical requirements for line pipe expressed as two product specification levels (PSL 1 and PSL 2). Level PSL 1 provides a standard quality level for line pipe. Level PSL 2 has additional mandatory requirements for chemical composition, notch toughness and strength properties and additional NDT. Requirements that apply to only PSL 1 or to only PSL 2 are so designated. Requirements that are not designated to a specific PSL designation apply to both PSL 1 and PSL 2 pipe.

The technical committee also recognized that the petroleum and natural gas industry often specifies additional requirements for particular applications. In order to accommodate such needs, optional additional requirements for special applications are available, as follows:

- PSL 2 pipe ordered with a qualified manufacturing procedure (Annex B), the requirements of which have been enhanced to include verification detail of critical processes in the production of feedstock material, line pipe manufacture and product testing and inspection;
- PSL 2 pipe ordered with resistance to ductile fracture propagation in gas pipelines (Annex G);
- PSL 2 pipe ordered for sour service (Annex H);
- Pipe ordered as “Through the Flowline” (TFL) pipe (Annex I);
- PSL 2 pipe ordered for offshore service (Annex J);

The following new annex is added to this Standard.

- Equations for threaded and coupled pipe and background equations for guided bend and CVN test (Annex P).

The requirements of the annex apply only when specified on the purchase order.

When pipe is ordered for dual or multiple applications, the requirements of more than one annex for special applications can be invoked. In such instances, if a technical conflict arises due to applying the requirements of more than one annex for special applications, the most stringent requirement applicable to the intended service shall apply.

This Standard does not provide guidance on when it is necessary to specify the above supplementary requirements. Instead, it is the responsibility of the purchaser to specify, based upon the intended use and design requirements, which, if any, of the supplementary requirements apply for a particular purchase order.

Consideration has been given to traditional symbols (denoting mechanical or physical properties or their values, dimensions or test parameters) and the format of equations that have been widely used and which (in their traditional format) maintain strong links with other widely used standards and specifications, and with the original scientific work that led to their derivation. Accordingly, some symbols and equations, most specifically those in 9.2 and Table F.1 and Annex P have been retained in their traditional form to avoid causing confusion. Where changes have been made, care has been taken to ensure that the new symbol replacing the traditional one has been fully and clearly defined.
Specification for Line Pipe

1 Scope

This Standard specifies requirements for the manufacture of two product specification levels (PSL 1 and PSL 2) of seamless and welded steel pipes for use in pipeline transportation systems in the petroleum and natural gas industries.

This Standard is not applicable to cast pipe.

2 Conformity

2.1 Units of measurement

In this Standard, data are expressed in both SI units and USC units. For a specific order item, only one system of units shall be used, without combining data expressed in the other system. Data values expressed in SI and USC units shall not be combined on the same inspection document or in the same required pipe marking sequence.

Where product is tested and verified against requirements using one measurement system (USC or SI), and an inspection document is issued, with data reported in the alternate measurement system units, a statement shall appear on the inspection document indicating that the data presented was converted from the measurement system used for the original inspection.

The purchaser shall specify whether data, drawings, and maintenance dimensions of pipes shall be in the International System (SI) or US Customary (USC) system of measurements. Use of an SI data sheet indicates the SI measurements shall be used. Use of a USC data sheet indicates the USC system of measurements shall be used.

For data expressed in SI units, a comma is used as the decimal separator and a space is used as the thousands separator. For data expressed in USC units, a dot (on the line) is used as the decimal separator and a space is used as the thousands separator.

2.2 Rounding

Unless otherwise stated in this Standard, to determine conformance with the specified requirements, observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with ISO 80000-1:2009/Cor 1:2011, Annex B, Rule A.

NOTE For the purposes of this provision, the rounding method of ASTM E29-04 [1] is equivalent to ISO 80000-1:2009/Cor 1:2011, Annex B, Rule A.

2.3 Compliance to this Standard

A documented quality system shall be applied to assist compliance with the requirements of this Standard.

NOTE Documentation of a quality system does not require certification by a third party certification body. Only the creation or adoption of a written quality system is necessary to meet the requirement of this standard. API defers to the expertise of responsible quality management personnel to create or adopt the system which best reflects the need of each company. There are many existing quality management systems to which personnel can refer to for