ASME B31T-2018
(Revision of ASME B31T-2015)

# Standard Toughness Requirements for Piping

## ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

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The next edition of this Code is scheduled for publication in 2021.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Code. Interpretations are published on the Committee web page and under http://go.asme.org/Interpretations. Periodically certain actions of the ASME B31 Committee may be published as Cases. Cases are published on the ASME website under the B31 Committee Page at http://go.asme.org/B31committee as they are issued.

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The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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# FOREWORD

In 2000, the ASME B31 Code for Pressure Piping, Materials Technical Committee (MTC) determined that there was a need to develop a standard set of toughness requirements for piping components that can be adopted by reference by the various piping codes and other codes and standards. At the time, the requirements of the ASME B31 Code books varied, with some having no requirements at all.

This Code is intended to provide requirements for evaluating the suitability of materials used in piping systems for piping that may be subject to brittle failure due to low-temperature service conditions.

Under direction of ASME Standards and Certification, both SI and U.S. Customary units are provided. The 2010 edition of this Code was approved by the American National Standards Institute (ANSI) on April 20, 2010.

The 2015 edition of the Code was approved by ANSI on October 21, 2015.

The 2018 edition of the Code was approved by ANSI on December 6, 2018.

# ASME B31 COMMITTEE
# Code for Pressure Piping

(The following is the roster of the Committee at the time of the approval of this Code.)

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# CORRESPONDENCE WITH THE B31 COMMITTEE

**General.** ASME Codes are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Code may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B31 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

**Proposing Revisions.** Revisions are made periodically to the Code to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Code. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Code. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

**Proposing a Case.** Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by the existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Code and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Code to which the proposed Case applies.

**Interpretations.** Upon request, the B31 Standards Committee will render an interpretation of any requirement of the Code. Interpretations can only be rendered in response to a written request sent to the Secretary of the B31 Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the B31 Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

| | |
|---|---|
| Subject: | Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words. |
| Edition: | Cite the applicable edition of the Code for which the interpretation is being requested. |
| Question: | Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a “yes” or “no” reply is acceptable. |
| Proposed Reply(ies): | Provide a proposed reply(ies) in the form of “Yes” or “No,” with explanation as needed. If entering replies to more than one question, please number the questions and replies. |
| Background Information: | Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information. |

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

**Attending Committee Meetings.** The B31 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B31 Standards Committee.

# ASME B31T-2018
# SUMMARY OF CHANGES

Following approval by the ASME B31 Committee and ASME, and after public review, ASME B31T-2018 was approved by the American National Standards Institute on December 6, 2018.

ASME B31T-2018 includes the following changes identified by a margin note, **(18)**.

| *Page* | *Location* | *Change* |
|---|---|---|
| 3 | 3.7.2.1 | Introductory paragraph revised |
| 3 | 3.7.2.2 | First paragraph revised |
| 4 | 3.7.2.3 | First and second paragraphs revised |
| 7 | 4.5.3 | Revised |
| 9 | Table 3.1-1 | (1) Notes (2) and (3) revised to include U.S. Customary units<br>(2) Notes (5) and (6) deleted, and references to them updated to Notes (2) and (3), respectively |
| 21 | Table 3.2-1 | (1) Second and third columns merged<br>(2) Fifth A194, second A420, third A671, third A672, and first "Various" entries revised<br>(3) Second A351 entry deleted<br>(4) A995 entry added |
| 31 | Figure I-1M | Revised |
| 32 | Table I-1 | Under "SI Units, Curve A," entry for 4.375 revised from "49" to "48" |
| 38 | Table III-1 | (1) Fifth CS −50, 13th and 15th CS B, second and third CS C, third and fifth CS D, first LA −150, eighth and ninth SS −20, and NI −325 entries revised<br>(2) Third SS −60 entry deleted<br>(3) Last SS −60 entry added |

# STANDARD TOUGHNESS REQUIREMENTS FOR PIPING

## 1 INTRODUCTION

This Code provides requirements for evaluating the suitability of materials used in piping systems for piping that may be subject to brittle failure due to low-temperature service conditions. While low-temperature service is usually considered to be below ambient temperature, brittle failure can occur at temperatures above ambient temperature for certain combinations of materials, thicknesses, and stress levels. The definition of "low-temperature service" as used in this Code, therefore, varies widely across the many applications for which piping systems are used. For a building service air line, low temperature may be 0°C (32°F), whereas for a cryogenic piping system, it could easily be −185°C (−300°F).[1] However, the principles used to evaluate the suitability of a piping system as related to service temperature by evaluating the toughness of the material can be applied across a wide temperature range, and this Code has been established to provide uniform guidance in this area. This Code may be invoked in whole or in part by various piping codes and/or specifications and is only mandatory when so invoked.

Suitability of piping systems for low-temperature service is a function of several variables, including material properties, design loadings, and fabrication procedures. The three primary factors that generally control the susceptibility for brittle fracture are material toughness, crack size, and tensile stress level. There are a wide variety of services in which low-temperature suitability need not even be considered; however, a screening criterion is necessary to determine this.

One objective of this Code is to provide a simple approach to evaluate whether additional consideration is necessary to evaluate suitability for low-temperature service. This is done by establishing a low-temperature service limit for various materials. Services at or warmer than this limit are not considered low temperature, and additional considerations relative to suitability are not required.

For services colder than this limit, various requirements are provided that, when met, qualify the material for low-temperature services. These requirements include impact testing, qualification of welding and other fabrication procedures, and limiting the design loadings.

The low-temperature service limit established herein is based on a reasonable degree of assurance that at this temperature the material will have a ductile failure mode. The actual ductile-to-brittle transition temperature for a given material specification will vary based on actual heat chemistry of the material and subsequent processing. For critical applications, the design engineer can select materials with a lower low-temperature service limit or require impact testing. On less-critical applications, material with a higher low-temperature service limit may be acceptable. The final selection is left to the referring code and the design engineer (when permitted by the referring code).

To keep the number of sets of requirements to a minimum, material groupings have been established, and a unique set of requirements has been provided for each group. These groups are assigned "T-numbers" for easy reference. Although most materials used in piping systems are listed, some are not, and these unlisted materials are not addressed in this Code. Where permitted by the code or specification invoking this Code, these requirements may be used for unlisted materials. The invoking code or specification may establish the correct T-number group for the material or may invoke the testing and other requirements of this Code using the worst-case assumption that the design minimum temperature is colder than the temperatures that would allow exemption from any of the requirements of this Code. The guidelines for establishing the correct T-number group are provided in Nonmandatory Appendix B.

## 2 GLOSSARY

*CVN:* the abbreviation for Charpy V-notch.

*design minimum temperature:* the lowest component temperature expected in service.

*fully deoxidized steel:* steel that has been deoxidized, either by the addition of strong deoxidizing agents or by vacuum treatment, to reduce the oxygen content to such a level that no reaction occurs between the carbon and oxygen during solidification. Also known as killed steel. Steels that are not fully deoxidized include rimmed, semi-killed, and capped steels. Limitations on the use of steels that are not fully deoxidized may be imposed by the applicable piping code or specification.

*lower critical temperature:* the temperature at which the first phase change occurs when heating a metal.

*low-temperature service limit:* the design minimum temperature at which additional requirements for low-temperature service do not apply.

*NDT temperature:* the nil ductility transition temperature.

*stress ratio:* the ratio of the design stress to an allowable stress. (See para. 3.6.2.)

[1] For guidance on cryogenic valves, refer to MSS SP-134, Valves for Cryogenic Service Including Requirements for Body/Bonnet Extensions.