ASME B31T-2010

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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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org as they are issued.

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FOREWORD

In 2000, the 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 B31 Code books varied, with some having no requirements at all.

This Standard 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 U.S. Customary and SI units are provided. This Standard was approved by the American National Standards Institute (ANSI) on April 20, 2010.

ASME B31 COMMITTEE
Code for Pressure Piping

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

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to

Secretary, B31 Committee
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Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. 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.

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

The request for 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.
Edition:	Cite the applicable edition of the Standard 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. 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 this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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 Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B31 Committee.

STANDARD TOUGHNESS REQUIREMENTS FOR PIPING

1 INTRODUCTION

This Standard 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 Standard, therefore, varies widely across the many applications for which piping systems are utilized. 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). 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 Standard has been established to provide uniform guidance in this area. This Standard 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 where low-temperature suitability need not even be considered; however, a screening criterion is necessary to determine this.

One objective of this Standard is to provide a simple approach to evaluate when 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 have been provided for each group. These groups are assigned "T-Numbers" for easy reference. Although most materials utilized in piping systems are listed, some are not, and these unlisted materials are not addressed in this Standard. Where permitted by code or specification invoking this Standard, these requirements may be utilized 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 Standard utilizing 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 Standard. The guidelines for establishing the correct T-Number group are provided in Nonmandatory Appendix B.

2 GLOSSARY

CVN: 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.

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