

# MANDATORY APPENDIX 5

## GUIDELINE ON THE APPROVAL OF NEW MATERIALS UNDER THE ASME BOILER AND PRESSURE VESSEL CODE

**Code Policy.** It is the policy of the ASME Boiler and Pressure Vessel Committee to adopt for inclusion in Section II only such specifications as have been adopted by the American Society for Testing and Materials (ASTM), by the American Welding Society (AWS), and by other recognized national or international organizations.

It is expected that requests for Code approval will normally be for materials for which there is a recognized national or international specification. For materials made to a recognized national or international specification other than those of ASTM or AWS, the inquirer shall give notice to the standards developing organization that a request has been made to ASME for adoption of their specification under the ASME Code and shall request that the organization grant ASME permission to reprint the specification. For other materials, a request shall be made to ASTM, AWS, or a recognized national or international organization to develop a specification that can be presented to the Code Committee.

It is the policy of the ASME Boiler and Pressure Vessel Committee to consider requests to adopt new materials only from boiler, pressure vessel, or nuclear power plant component Manufacturers or users. Further, such requests should be for materials for which there is a reasonable expectation of use in a boiler, pressure vessel, or nuclear power plant component constructed to the rules of one of the Sections of this Code. Requests for new materials shall be accompanied by a communication from an ASME Certificate Holder, an end user, or an organization that specifies materials and contracts with Certificate Holders for the construction of products to the rules of one of the Sections of this Code. The letter shall state the inquirer's name and status as one of these three types of organizations.

**Application.** The inquirer shall identify to the Committee the Section or Sections and Divisions of the Code in which the new material is to be incorporated, the temperature range of application, whether cyclic service is to be considered, and whether external pressure service is to be

considered. The inquirer shall identify all product forms, size ranges, and specifications for which incorporation is desired.

**Mechanical Properties.** Together with the specification for the material, the inquirer shall furnish the Committee with adequate data on which to base design values for inclusion in the applicable tables. The data shall include values of ultimate tensile strength, yield strength, reduction of area, and elongation, at 100°F intervals, from room temperature to 100°F above the maximum intended use temperature, unless the maximum intended use temperature does not exceed 100°F. Any heat treatment that is required to produce the mechanical properties should be fully described.

If adoption is desired at temperatures at which time-dependent behavior may be expected to control design values, stress-rupture and creep rate data for these time-dependent properties shall be provided, starting at temperatures about 50°F below the temperature where time-dependent properties may govern (see Appendix 1 of Section II, Part D) and extending to about 100°F above the maximum intended use temperature. The longest rupture time at each test temperature must be in excess of 6,000 hr and the shortest about 100 hr, with at least three additional tests at stresses selected to provide rupture times nominally equally spaced in log (time); i.e., times nominally of 100, 300, 800, 2,200, and 6,000 hr at each test temperature. Obviously, longer times and additional tests are beneficial. The interval between successive test temperatures shall be chosen such that rupture lives shall not differ by more than a factor of about 10 at any given stress for two adjacent temperatures. In general, test temperatures should be in about 50°F intervals if maximum test times are no longer than 6,000 hr. The goal of the testing is to facilitate data analysis to estimate the average and minimum stresses for rupture in 100,000 hr and an average creep rate of  $10^{-5}$  %/hr for each temperature where design stresses are established. Alternative test plans that deviate from the prior description

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but achieve the overall objective may be considered.

Minimum creep rate data shall be provided over the same range of temperatures as above, with the lowest stress at each temperature selected to achieve a minimum creep rate of  $1.0$  to  $2.0 \times 10^{-4}$  %/hr or less. Creep rate data may be obtained in the course of stress-rupture testing or may be obtained on additional specimens. If it can be conclusively demonstrated that creep rate does not control the design stresses, the creep rate data may be sparse in relation to the stress-rupture data. Submission of creep curves for evaluation of creep rate behavior is acceptable and encouraged.

For materials that will be used in welded applications, sufficient time-dependent data shall be provided for weldments and filler metals to allow ASME to assess the properties in comparison with the base material. In the time-dependent range, this includes providing stress-rupture data for specimen tests in excess of 6,000 hr at each temperature and for each welding process. In addition, minimum creep rate data on filler metals shall also be provided to rates below  $1.0$  to  $2.0 \times 10^{-4}$  %/hr.

If adoption at temperatures below room temperature is requested, and if it is desired to take design advantage of increased strength at lower temperatures, data on the time-independent properties shall be provided at  $100^\circ\text{F}$  intervals to and including the lowest intended use temperature.

Notch toughness data shall be provided for materials for which Code toughness rules would be expected to apply. The data shall include test results for the intended lowest service metal temperature and for the range of material thicknesses desired. For welded construction, the notch toughness data shall include the results of Code toughness tests for weld metal and heat-affected zone for weldments made by the intended welding processes.

If the material is to be used in components that operate under external pressure, stress-strain curves (tension or compression) shall be furnished, at  $100^\circ\text{F}$  intervals over the range of design temperatures desired. Stress-strain information in the form of diagrams and digitized data shall be provided up to at least 1% strain. Digitized stress-strain data shall be in intervals not greater than 0.1% strain, except a smaller interval may be necessary in the area above the proportional limit in the region where the slope of the curve changes most drastically. In addition, the yield strength, modulus of elasticity, and proportional limit shall be identified. The stress-strain curve (not load versus extension) shall be determined using a Class B-2 or better accuracy extensometer as defined in ASTM E 83. Numerical data, when available, should be submitted. The data should include the original cross-sectional area of the test specimen and stress-strain curves with units marked on them.

If the material is to be used in cyclic service and the Construction Code in which adoption is desired requires explicit consideration of cyclic behavior, fatigue data shall also be furnished over the range of design temperatures desired.

In general, for all mechanical properties, data shall be provided from at least three heats of material meeting all of the requirements of a specification for at least one product form for which adoption is desired, for each test at each test temperature. When adoption for both cast and wrought product forms is desired, data from at least three heats each of a wrought and of a cast product form shall be submitted. It is desired that the data represent all product forms for which adoption is desired. For product forms for which the properties may be size dependent, data from products of different sizes, including the largest size for which adoption is desired, shall be provided.

Test methods employed shall be those referenced in or by the material specifications, or shall be appropriate ASTM test methods or recommended practices for the properties tested.

Information describing service experience in the temperature range contemplated will be useful to the Committee.

**Other Properties.** The inquirer shall furnish to the Committee adequate data necessary to establish values for coefficient of thermal expansion, thermal conductivity and diffusivity, Young's modulus, shear modulus, and Poisson's ratio, when the Construction Code in which adoption is desired requires explicit consideration of these properties. Data shall be provided over the range of temperatures for which the material is to be used.

**Weldability.** The inquirer shall furnish complete data on the weldability of material intended for welding, including data on procedure qualification tests made in accordance with the requirements of Section IX. Welding tests shall be made over the full range of thickness in which the material is to be used. Pertinent information, such as postweld heat treatment required, susceptibility to air hardening, effect of welding procedure and heat-affected zone and weld metal notch toughness, and the amount of experience in welding the material shall be given.

**Physical Changes.** For new materials, it is important to know the structural stability characteristics and the degree of retention of properties with exposure at temperature. The influence of fabrication practices, such as forming, welding, and thermal treatment, on the mechanical properties, ductility, and microstructure of the material are important, particularly where degradation in properties may occur. Where particular temperature ranges of exposure or heat treatment, cooling rates, combinations of mechanical working and thermal treatments, fabrication practices, exposure to particular environments, etc., cause significant changes in the mechanical properties, microstructure,

resistance to brittle fracture, etc., it is of prime importance to call attention to those conditions that should be avoided in service or in manufacture of parts or vessels from the material.

**Requests for Additional Data.** The Committee may request additional data, including data on properties or material behavior not explicitly treated in the Construction Code in which adoption is desired.

**New Materials Checklist.** To assist inquirers desiring Code coverage for new materials, or extending coverage of existing materials, the Committee has developed the following checklist of items that ought to be addressed by each inquiry. The Committee reserves the right to request additional data and application information when considering new materials.

- (a) Has a qualified inquirer request been provided?
- (b) Has a request either for revision to existing Code requirements or for a Code Case been defined?
- (c) Has a letter to ASTM or AWS been submitted requesting coverage of the new material in a specification, and has a copy been submitted to the Committee? Alternatively, is this material already covered by a specification issued by a recognized national or international organization and has an English language version been provided?
- (d) Has the Construction Code and Division coverage been identified?
- (e) Has the material been defined as ferrous or nonferrous and has the application (product forms, size range, and specification) been defined?
- (f) Has the range (maximum/minimum) of temperature application been defined?
- (g) Has mechanical property data been submitted (ultimate tensile strength, yield strength, reduction of area, and elongation at 100°F intervals, from room temperature to 100°F above the maximum intended use temperature for three heats of appropriate product forms and sizes)?
- (h) If requested temperatures of coverage are above those at which time-dependent properties begin to govern design values, has appropriate time-dependent property data for base metal, weld metal, and weldments been submitted?
- (i) If coverage below room temperature is requested, has appropriate mechanical property data below room temperature been submitted?
- (j) Have toughness considerations required by the construction Code been defined and has appropriate data been submitted?
- (k) Have external pressure considerations been defined and have stress–strain curves been submitted for the establishment of external pressure charts?
- (l) Have cyclic service considerations and service limits been defined and has appropriate fatigue data been submitted?

(m) Has physical properties data (coefficient of thermal expansion, thermal conductivity and diffusivity, Young's modulus, shear modulus, Poisson's ratio) been submitted?

(n) Have welding requirements been defined and has procedure qualification test data been submitted?

(o) Has influence of fabrication practices on material properties been defined?

**Requirements for Requests for ASME Acceptance of Material Specifications of Recognized National or International Organizations Other Than ASTM or AWS.** The Committee will consider only requests for specifications in the English language and in U.S. or SI/metric units. The Committee will consider accepting specifications of recognized national or international organizations, such as, but not limited to, American Petroleum Institute (API), ASTM, AWS, Canadian Standards Association (CSA), European Committee for Standardization (CEN), and Japanese Standards Association (JIS). Material specifications of other than national or international organizations, such as those of material producers and suppliers, will not be considered for acceptance.

**Requirements for Recognized National or International Specifications.** Acceptable material specifications will be identified by date or edition. Approved edition(s) will be stated in the subtitle of the ASME specification. Eventually, acceptable previous editions will be listed in Section II, Parts A and B. Minimum requirements that must be contained in a material specification for which acceptance is being requested include such items as name of national or international organization, scope, reference documents, process, manufacture, conditions for delivery, heat treatment, chemical and tensile requirements, forming properties, testing specifications and requirements, workmanship, finish, marking, inspection, and rejection.

**Publication of Recognized National or International Specifications.** Specifications for which ASME has not been given permission to publish by the originating organization will be referenced on a cover sheet in Section II, Parts A and B. Information on obtaining a copy of those documents will be maintained in Nonmandatory Appendix A of those Parts. Documents that are referenced in accepted national or international material specifications will not be published by ASME. However, information on obtaining a copy of those documents will be maintained in Nonmandatory Appendix A of Section II, Parts A and B. Additions and exceptions to the material specification will be noted in the subtitle of the specification.

**Code Case.** The Code Committee will consider the issuance of an ASME Code Case, to be effective for a period of 3 years, permitting the use of a new material, provided that the following conditions are met:

- (a) the inquirer provides evidence that a request for coverage of the material in a specification has been made

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to ASTM or a recognized national or international organization;

(b) the material is commercially available and can be purchased within the proposed specification requirements;

(c) the inquirer shows that there will be a reasonable demand for the material by industry and that there exists an urgency for approval by means of a Code Case;

(d) the requests for approval of the material shall clearly describe it in specification form, including such items as

scope, process, manufacture, conditions for delivery, heat treatment, chemical and tensile requirements, forming properties, testing specifications and requirements, workmanship, finish, marking, inspection, and rejection;

(e) all other requirements identified previously under Code Policy and Application apply; and

(f) the inquirer shall furnish the Code Committee with all the data specified in this Appendix.