



PV Newsletter

Monthly Publication from CoDesign Academy

General Requirements for All Materials

The requirements of Part UG are applicable to all pressure vessels and vessel parts and are to be used in conjunction with specific requirements in Subsections B and C and the Mandatory Appendices that pertain to the methods of fabrication and the material used.

Materials

The material, which is subject to stresses due to pressure, used in the construction of pressure vessel must conform to:

- a) One of the specifications given in ASME BPVC Section II, Part D, Tables 1A, 1B and 3, AND
- b) Shall be limited to that are permitted in the applicable parts of Subsection C and Mandatory Appendices of ASME B&PV Section VIII, Div. 1 (Code)

The material used may meet more than one specification provided the material meets all the requirements of the identified material specifications.

Materials for non-pressure parts such as skirts, supports, baffles, lugs, clips, and extended heat transfer surfaces, need not conform to the specifications for the material to which they are attached or to a material specification permitted in the Code. However, if they are attached to the vessel by welding, they shall be of a weldable quality. The allowable stress values for these materials shall not exceed 80% of the maximum allowable stress value permitted for a similar material in Subsection C.

Section II, Part D, Tables 1A give the **Maximum Allowable Stress Values for Ferrous Materials**

Section II, Part D, Tables 1B give the **Maximum Allowable Stress Values for Non-Ferrous Materials**

Section II, Part D, Tables 3 give the **Maximum Allowable Stress Values for Bolting Materials**

Materials other than those allowed by the Code should not be used unless data is submitted to and approved by the Boiler and Pressure Vessel Committee.

It is the responsibility of the user or his agent to ensure that the materials used for the construction of pressure vessel will be suitable for the intended service with respect to retention of satisfactory mechanical properties, and resistance to corrosion, erosion, oxidation, and other deterioration during their service life.

Plates	Plate materials shall conform to one of the specifications in ASME Section II for which allowable stress values are given in tables referenced in this Code.
Forgings	Forged materials should have been worked sufficiently to remove the coarse ingot structure.
Castings	The allowable stress values for cast materials shall be multiplied by the applicable casting quality factors.

Pipes and Tubes

Pipe and tube materials shall conform to one of the specifications in ASME Section II for which allowable stress values are given in tables referenced in this Code.

Integrally finned tubes may be made from tubes that conform in every respect with one of the specifications given in ASME Section II. The tubes after finning shall have a temper or condition that conforms to one of those provided in the governing specifications, or, when specified, they may be furnished in the “as-fabricated condition” where the finned portion of the tube are in cold worked temper resulting from finning operation, and the unfinned portions in the temper of the tube prior to finning.

The maximum allowable stress value for the finned tube shall be that for the tube before finning. The maximum allowable internal or external working pressure of the tube shall be based on the root diameter and the minimum wall of the finned section, or the outside diameter and the wall of the unfinned section together with appropriate stress values, whichever results in lower maximum allowable working pressure.

In addition to the tests required by the governing specifications, each tube after finning shall be subjected to a pneumatic test or a hydrostatic test as indicated below:

1. An internal pneumatic test of not less than 1.7 MPa (250 psi) for 5 seconds without evidence of leakage. The test method shall permit easy visual detection of any leakage such as immersion of the tube under water or pressure differential method.
2. An individual tube hydrostatic test in accordance with this Code that permits complete examination of tube for leakage.

The Code does allow the use of materials identified with, or produced to a specification not permitted by the Code, and materials not fully identified, *WITH SOME RESTRICTIONS*. These restrictions are described below:

a. Material Identified with a specification not permitted by the Code

Material identified with a specification not permitted by the Code, or procured to chemical composition requirements, and identified to a single production lot, as required by a permitted specification may be accepted as satisfying the requirements of this Code, provided the following conditions are satisfied:

1. Recertification by an organization other than the vessel or part manufacturer - All requirements, including but not limited to, melting method, melting practice, de-oxidation, quality, and heat treatment, of the specification permitted by this Code have been met and so demonstrated. A copy of certification by the material manufacturer of the chemical analysis required by the permitted specification, with the documentation showing the requirements to which the material was produced and purchased, and which demonstrates that there is no conflict with the requirements of the permitted specification, has been furnished to the vessel or part manufacturer. A certification that the material was manufactured and tested in accordance with the requirements of the specification, to which the material is recertified, excluding the specific marking requirements, has been furnished to the vessel or part manufacturer, together with copies of all documents and test reports pertinent to the demonstration of conformance to the requirements of permitted specification. The material and the certificate of compliance or the material test report have been identified with the designation of the specification to which the material is recertified, and with the notation “Certified per UG-10.”
2. Recertification by vessel or part manufacturer - A copy of the certification by the material manufacturer of the chemical analysis required by the permitted specification, with the documentation showing the requirements to which the material was produced and purchased,

and which demonstrates that there is no conflict with the requirements of the permitted specification is available to the inspector. Documentation is available to the inspector that demonstrates that the metallurgical structure, mechanical property and the hardness requirements of the permitted specification have been met. The material has markings acceptable to the inspector, for identification to the documentation. Further,

- i. Where the maximum allowable stresses are subject to cautionary note, documentation is available to the inspector that establishes what de-oxidation was performed during the material manufacture, to the degree necessary for the vessel or part manufacturer to make a decision with respect to the cautionary note.
- ii. Where material requires a fine austenitic grain size or that requires that a fine grain practice be used during melting, documentation is available to the inspector that demonstrates that the heat treatment requirements of the permitted specification have been met, or will be met during fabrication.

When the conformance of the material with the permitted specification has been established, the material can be marked as required by the permitted specification.

b. Material identified to a particular production lot as required by a specification permitted by the Code, but for which documentation required in a) is not available

In such cases, chemical analyses are made by the vessel or part manufacturer on different pieces from the lot to establish a mean analysis that is to be accepted as representative of the lot. The pieces chosen for analysis shall be selected at random from the lot. The number of pieces selected shall not be less than 10% of the number of pieces in the lot, but not less than three. For lots of three pieces or less, each piece shall be analysed. Analyses need only be made for those elements required by the permitted specification; however, consideration should be given to making analyses for elements not specified by the specification but that would be deleterious if present in excessive amounts.

Each individual analysis for an element (required by the permitted specification) shall conform to the limits for product analysis in the permitted specification, and the mean for each element shall conform to the heat analysis limits of that specification.

Mechanical property tests are made in accordance with the requirements of the permitted specification and the results of the test conform to the specified requirements. Further,

1. Where maximum allowable stresses are subject to a cautionary note, chemical analysis results are obtained that are sufficient to establish what de-oxidation was used during material manufacture, to the degree necessary for making a decision with regard to the cautionary note.
2. Where the requirements of the permitted specification include metallurgical structure requirements (i.e. fine austenitic grain size), tests are made and the results are sufficient to establish that those requirements of the specification have been met.
3. Where the requirements of the permitted specification include heat treatment, the material is heat treated in accordance with those requirements, either prior to or during fabrication.

When the conformance of the material with the permitted specification has been established, the material can be marked as required by the permitted specification.

c. Material that cannot be qualified either under a) or b)

In cases where the material cannot be fully identified, each piece must be tested by the vessel or part manufacturer to show that it meets the chemical composition for product analysis and the mechanical properties requirements of the permitted specification. Chemical analyses need only be made for those elements required by the permitted specification; however, consideration should be given to making analyses for elements not specified by the specification but that would be deleterious if present in excessive amounts. Additionally,

1. For plates, when the direction of final rolling is not known, both a transverse and a longitudinal tension test specimen shall be taken from each sampling location designated in the permitted specification. The results of both tests shall conform to the minimum requirements of the specification, but the tensile strength of only one of the two specimens need conform to the maximum requirement.
2. Where maximum allowable stresses are subject to a cautionary note, chemical analysis results are obtained that are sufficient to establish what de-oxidation was used during material manufacture, to the degree necessary for making a decision with regard to the cautionary note.
3. Where the requirements of the permitted specification include metallurgical structure requirements (i.e. fine austenitic grain size), tests are made and the results are sufficient to establish that those requirements of the specification have been met.
4. Where the requirements of the permitted specification include heat treatment, the material is heat treated in accordance with those requirements, either prior to or during fabrication.

When the identity of the material with the permitted specification has been established, each piece is marked with a marking giving the permitted specification number and grade, type or class as applicable and a serial number identifying the particular lot of material. A suitable report, clearly marked as being a "reports on Tests of Nonidentified Material," shall be completed and certified by the vessel or part manufacturer. This report, when accepted by the inspector, shall constitute the authority to use the material in lieu of the material procured to the requirements of the permitted specification.

Prefabricated or Preformed Pressure Parts

Prefabricated or pressure parts for pressure vessels that are subject to pressure, and are furnished by other than the location of manufacturer responsible for the vessel to be marked with Code symbol shall conform to all the applicable requirements of the Code, including service restrictions applicable to the material, inspection in the shop of parts manufacturer, and the furnishing of partial data reports. Manufacturers with multiple locations, each with its own Certificate of Authorization, may transfer its pressure vessel parts from one location to another without partial data reports, provided the Quality Control System describes the method of identification, transfer and receipt of parts. When prefabricated or preformed parts are furnished with a nameplate and the nameplate interferes with further fabrication or service, and where stamping on the material is prohibited, the manufacturer of the completed vessel with the concurrence of the Authorized Inspector may remove the nameplate. The removal of the nameplate shall be noted in the "Remarks" section of the vessel's manufacturer data report. The nameplate shall be destroyed.

The exceptions are as describes below (these parts need not be manufactured by a Certification of Authorization Holder):

Cast, Forged, Rolled, or Die-formed Standard Pressure Parts

Standard pressure parts such as pipe fittings, flanges, nozzles, welding necks, welding caps, manhole frames and covers, that are formed by casting, forging, rolling, or die forming shall not require inspection, identification in accordance with standard procedures, or partial data reports. These standard pressure parts must comply with some ASME standard or Manufacturer's standard, and shall be made from a material permitted by the Code. These parts shall be marked with name or trademark as required by the standard. Such markings shall be considered as part's manufacturer's certification that the product complies with material specifications and standards indicated and is suitable for service at rating indicated.

Flanges and flanged fittings may be used at the pressure-temperature ratings specified in the appropriate standard. Other pressure-temperature ratings may be used if the flange satisfies the design requirements of UG-34, or Appendix 2.

Small parts that are used for relatively unimportant parts or parts stressed to not more than 50% of the stress values permitted by the Code are not required to have identification in accordance with standard procedures. Such parts should not appreciably affect the safety of the vessel and the manufacturer of the vessel must satisfy himself that the part is suitable for design conditions specified for the vessel.

Cast, Forged, Rolled, or Die-formed Non-standard Pressure Parts

Pressure parts such as shells, heads, removable doors, and pipe coils that are wholly formed by casting, forging, rolling, or die forming may be supplied basically as materials. All such parts shall be made of materials permitted by the Code and the Manufacturer must supply the required identification for the part. Parts shall be marked with the name or trademark of parts manufacturer and any such other markings as will serve to identify the particular parts with the accompanying material identification.

Welded Standard Pressure Parts for Use Other Than the Shell or Heads of a Vessel

Additionally, the following pressure parts do not required inspection, identification to standard procedures or partial data reports:

1. Standard pressure parts complying to some ASME or Manufacturer's standard and made from materials permitted by the Code.
2. Welding for pressure parts in 1) shall comply with the requirements of the Code. Markings, where applicable, or certification where markings are not applicable shall be accepted as evidence of compliance with the welding requirements. The parts shall be marked with name or trademark of the parts manufacturer that will serve to identify materials from which they are made.
3. If radiography or post weld heat treatment is required, it may be performed either in part of part manufacturer or in the plant of vessel manufacturer. In case, radiography is done at plant of part manufacturer, the completed radiographs, properly identified, with a radiographic inspection report shall be forwarded to the vessel manufacturer.
4. If heat treatment is performed at plant of parts manufacturer, certification by the parts manufacturer that such treatment was performed shall be accepted as evidence of compliance with the Code requirements.

Bolts and Studs

Specifications, supplementary rules, and maximum allowable stress values for acceptable bolting materials are given in tables referenced in UG-23.

Studs shall be threaded full length or shall be machined down to root diameter in the unthreaded portion provided that the threaded portions are at least 1 ½ times diameter in length. Studs greater than eight diameters in length may have unthreaded portion that has the nominal diameter of the thread, provided the following requirements have been met:

1. The threaded portion shall be at least 1 ½ times the diameter in length.
2. The stud shall be machined down to the root diameter of the thread for a minimum distance of 0.5 diameters adjacent to the threaded portion.
3. A suitable transition shall be provided between the root diameter and the unthreaded portion.
4. Particular consideration should be given to any dynamic loadings.

Nuts and Washers

Nuts shall engage the threads for the full depth of the nut. The use of washers is optional; when used they must be of wrought material.

Rods and Bars

Rods and bars may be used in pressure vessel construction for pressure parts such as flange rings, stiffening rings, frames for reinforced openings, stays and staybolts, and similar parts.

Except for flanges of all types, hollow cylindrically shaped parts [up to and including NPS 4 (DN 100)] may be machined from rod or bar, provided that the axial length of the part is approximately parallel to the metal flow lines.

Other parts, such as heads or caps [up to and including NPS 4 (DN 100)], not including flanges, may be machined from rod or bar.

Elbows, return bends, tees and header tees shall not be machined directly from rod or bar.

When there is no material specification listed in Subsection C covering a particular wrought product of a grade, but there is an approved specification listed in Subsection C covering some other wrought product of that grade:

The particular product may be used provided that

- The chemical and physical properties, heat treating requirements, and requirements for de-oxidation, or grain size requirements conform to the approved specification listed in Subsection C.
- The manufacturing procedures, tolerances, tests, and markings are in accordance with ASME-Section II specification covering the same product of a similar material.
- For the case of welded tubing made of plate, sheet or strip, without the addition of filler metal, the appropriate stress values are multiplied by a factor 0.85.
- The product is not pipe or tubing fabricated from fusion welding with the addition of filler metal unless it is fabricated in accordance with the rules of this Code as a pressure part.
- The mill test reports reference the specifications used in producing the material, and in addition, make reference to paragraph UG-15.

Sources:

1. ASME Boiler & Pressure Vessel Code, Section VIII, Division 1: Edition 2010

***** END OF THE ARTICLE *****

About CoDesign Engineering

CoDesign Engineering is involved in projects that promote sustainable development and improvement in system efficiencies with specific focus on energy and waste management. Its operations can be broadly classified into following business groups:

- ❖ Pressure Vessels and Heat Exchangers
- ❖ Combined Cycle Power Plants
- ❖ Solar Photovoltaic Power Plants
- ❖ Solid Waste Management

We provides training, consultancy, and operation and maintenance services as described below:

Training

- ❖ Pressure vessel & heat exchanger design (ASME Section VIII, Div. 1)
- ❖ Power piping design (ASME B31.1 & B31.3)
- ❖ Combined cycle power plant system design
- ❖ Solar PV power plant design

Consultancy

- ❖ Supply and installation of static equipment in power plants and refineries
- ❖ Project Management Consultancy for construction of combined cycle power plants
- ❖ PMC as well as EPC services for solar PV power plants
- ❖ Turnkey waste management solutions, including disposal of e-waste

We have designed a 3-day training course for ASME BPVC Section VIII, Div. 1 that can be offered at most cities in India. In-house training can also be provided at any location in India or in US upon request. The training is designed as a workshop where the delegates are encouraged to do all calculations using only pencil, paper and calculators. Please contact Ramesh Tiwari at rtiwari123@gmail.com for 2012 training calendar, rates and the contents of the course.

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