# INITIATING REQUIREMENTS FOR

# CERTIFYING ENGINEER IN

# ASME SECTION VIII DIVISION 1 PRESSURE VESSEL CODE

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## Introduction

The 2021 Edition of ASME Section VIII, Division 1 will contain new rules requiring the following:

- Use of the User's Design Requirements form (see Appendix KK)
- Manufacturer's responsibility to ensure the competence of personnel performing design activities
- New definitions for Certifying Engineer and designer
- Manufacturer's responsibilities to ensure programs used for design are verified as being correct to the current edition
- Requirements for Certifying Engineers and designers

The origin of these requirements is based on a letter from a long-standing Committee member regarding the use of Division 1 clause U-2(g). At the time of the letter, the clause read:

> This Division of Section VIII does not contain rules to cover all details of design and construction. Where complete details are not given, it is intended that the Manufacturer, subject to the acceptance of the Inspector, shall provide details of design and construction which will be as safe as those provided by the rules of this Division.

A key point made by the member in his letter of August 1, 2008 to the BPV Section VIII Standards Committee was:

> I believe it is necessary to emphasize that the design formulas and other construction provisions in the ASME Code must be used for design and construction. It seems clear that "designers" feel that use of computers and finite element programs trump the requirement for complying with the design and construction rules currently in the Code. In the cases I am referring to, the "designers" had no ties to the fabricators and no manufacturing experience. In other words, the "designers" did not understand the ASME Code philosophy.

This letter led to the formation of Task Group U-2(g) in January 2011 with the following charter requirements:

(1) To review the provisions of U-2(g) in Section VIII, Division 1 and determine whether the paragraph applies to all details of construction, or design only.
(2) To consider the option of introducing mandatory third-party verification of all design

calculations. If this option is endorsed, the Task Group shall prepare the necessary code revisions to implement the change.

A series of actions have been approved and implemented regarding Charter requirement 1. Charter requirement number 2 has been approved and is set to be published in the 2021 Edition, release date July 1, 2021 with mandatory implementation January 1, 2022.

Purpose

This paper will provide detailed information and explanations regarding each of the changes in Division 1 along with the intent the rule is trying to provide. Examples or other guidance will be provided where appropriate.

Detailed Changes

*U-1 – Scope*

Clause U-1(a)(3) is being revised by removal of the final sentence. The reason for this is to relocate to a new clause in U-2(a)(1)(-c).

*U-2 – General*

Clause U-2(a) has significant revisions as follows:

- Reference to UG-22 in first paragraph is deleted
- The sentence, “Such consideration shall include but not be limited to the following:” becomes sub-clause (1)
- Sub-clause (-a) has been added to consider the loadings listed in UG-22
- The need for corrosion allowance becomes sub-clause (-b)
- A new sub-clause (-c) is added to relocate the deleted text from U-1(a)(3) by referencing damage mechanisms and service restrictions. Reference is made to ASME Section II, Part D, Appendix A, API RP 571 and WRC Bulletins 488, 489 and 490. Another reference is made to UG-120(d) which is where the full listing of special services is located with reference to other sections of the Code that provide the specific service restrictions. This new clause replaces existing U-1(a)(2).
- U-2(a)(3), (4) and (5) have been renumbered as (-d), (-e) and (-f) respectively.
- A new U-2(a)(2) clause that mandates the use of the UD-R form from Appendix KK under certain situations. Explicit permission is granted to use a different form provided equivalent information is provided. The following UG-22 loadings dictate the use of Form UD-R:
    - Superimposed static reactions – UG-22(c)
    - Cyclic or dynamic reactions – UG-22(e)
    - Loadings due to wind, snow or seismic reactions – UG-22(f)
    - Impact reactions – UG-22(g)
    - Temperature effects – UG-22(h)
    - Abnormal pressures – UG-22(i)

Clause U-2(a) commentary

The primary basis for these changes is from a 1997 paper written by James Farr, a long-standing member of BPV Section VIII. Mr. Farr was also the Chairman of the Subcommittee beginning in the 1980's. A copy of this paper is provided.
Mr. Farr explained the historical context of the UG-22 loadings; prior to 1952 Edition, these were more guidance statements. In the 1952 Edition, the word "shall" was entered making consideration of the loadings a mandatory code requirement. Thus, the Manufacturer is obligated to show each item has been considered either by calculation or by explanation and is considered acceptable.
This has led to misunderstanding by both users and Manufacturers. Since the loadings are not listed in an area of the Code with explicit requirements for consideration, users tended to ignore in purchase specifications. Manufacturers, when receiving specifications with no loadings indicated, simple assumed they are not applicable.
The Committee has reviewed the loadings and deemed the loadings stated in the new clause as essential information the Manufacturer must know so that proper design can commence.

Clause U-2(b) has significant revisions as follows:

- A new U-2(b)(1) that states the Manufacturer is responsible for the structural and pressure retaining integrity of the vessel or parts as established by the Code and by any additional requirements of the User's Design Requirements Form. Further, the Manufacturer must now indicate on the U-1 Data Report any of the loadings that were considered. Further, Appendix NN, Table NN-6-7 is being revised to stipulate this requirement as well.
- The current U-2(b)(1) is renumbered as (2)
- A new U-2(b)(3) is added that states the Manufacturer is responsible to ensure all personnel performing design activities are qualified. Reference to the new Appendix 47 is provided. The clause also states the Manufacturer must report methods of design not covered by the rules as permitted by U-2(g).

Clause U-2(b) commentary

Stating the Manufacturer is responsible for the structural and pressure retaining integrity is essentially copied from Section VIII, Division 2; see Part 2, 2.3.1.1. The Committee believes there is no reason to be different with this regard. This is also similar to language in Division 3 under KG-321.
The requirement to indicate on the Manufacturer's Data Report the loadings considered ensures the user, the Authorized Inspector and the Jurisdiction Having Authority understand all applicable loadings have been considered and will align with those listed on the User's Design Requirements Form.

The requirement for the Manufacturer to ensure design personnel are qualified is essentially the incorporation of Charter Requirement 2. The Task Group considered various options on how to verify Code calculations. Options considered included:

- A Notified Body approach, similar to European Norm

- Recommendations for jurisdictional oversight to design similar to the Province of Alberta, Canada
- Use of Registered Professional Engineers as is done by Section VIII, Divisions 2 and 3 as well as by ASME Section III

Of these three options, the Committee selected the RPE option because they believe it will have the least disruption to industry and it is very similar in nature to the requirements of Division 2, see Annex 2-J.

Similar to Division 2 and the addition of Annex 2-J, Division 1 now has Appendix 47 where the qualifications and requirements of design personnel are provided. Note that there are instances where an RPE is required, and other instances where one is not required.

*Appendix 3*

A new definition for Certifying Engineer is provided:

> *Certifying Engineer* - an engineer or other technical professional duly accredited and qualified to practice engineering activities as required by this Division

A new definition for designer is provided:

> *designer:* an individual who is qualified to design pressure vessels in accordance with the rules of this Division by demonstrated knowledge in Code requirements and proficiency in selecting correct design formulas and appropriate values to be used when preparing the design of a pressure vessel

The basis for these additions are from Section VIII, Division 2 and from Section III to ensure better consistency between the Divisions and within the BPV Code.

*Appendix 10*

A new requirement under the Manufacturer's Quality Control System is provided for 10-5, relative to procedures. The Manufacturer is required to have procedures in place for the following:

- Verification of computer programs used for Code design activities
- Establishing and documenting personnel qualifications.

The Code is not being updated to address *how* a Manufacturer will verify the calculations. However, simple guidance is provided pointing to ASME PTB-4, the Section VIII, Division 1 Example Manual as a means to achieve program verification.

*Appendix 47*
This new appendix states mandatory requirements for pressure vessel designers.

- In 47-1, it states a mandatory requirement for a qualified person to be in *responsible charge* of the design activities. The actual requirements for the person in responsible charge will depend on the design complexity and the individual's experience.
- 47-2 outlines requirements for Certifying Engineers, engineers and designers who are designated as being in responsible charge. A Manufacturer may also comply with Appendix 47 when following Section VIII, Division 2 requirements. This eliminates 2 separate programs being required.
    - Certifying engineers must be
        - registered professional engineers in the US or Canada, or;
        - Listed in the International Register of Professional Engineers, or;
        - Registered with a country that is a member of the Asia Pacific Economic Cooperation, or;
        - Registered with a country that is a member of the European Federation of National Engineering Associations
    - Engineers must
        - Have a four year university or college degree in engineering from an accredited institution, and;
        - Have 4 or more years of experience designing pressure vessels
    - Designers must
        - Have a two year engineering technician or associates degree and six years of experience designing pressure vessels, or;
        - Have ten or more years of designing pressure vessels
- 47-3 is provided as an alternative, intended primarily for small companies with limited staff, and potentially larger turnover in design personnel. It provides alternative amounts of experience for either the engineer, or the designer in lieu of the mandated 4, 6 or 10 years respectively from 47-2.
    - 47-3 does not provide an alternative to Certifying engineers
    - 47-3 is intended for Manufacturers with limited design and production facilities engaged in simple pressure vessel production
    - 47-3 is intended to allow the Manufacturer to set the minimum number of years of experience required for an engineer or designer to be in responsible charge

Clause 47-3 Commentary

During Committee deliberations of Appendix 47, a discussion on engineers that are employed directly under contract by "small to medium-sized shops that service specific industries" will be affected by the proposed addition. Examples of manufacturers include those that service food, pharmaceutical or semiconductor industries. Also, smaller companies in many instances serve as training grounds for engineers that have just completed their university training.

While the intent of this clause is for use by "small companies" there is no prohibition on its use by any Certificate Holder. It is the manufacturer's responsibility to document and provide objective evidence that Appendix 47 requirements are being met. The documents and objective evidence showing compliance to Appendix 47 must be available to the AI

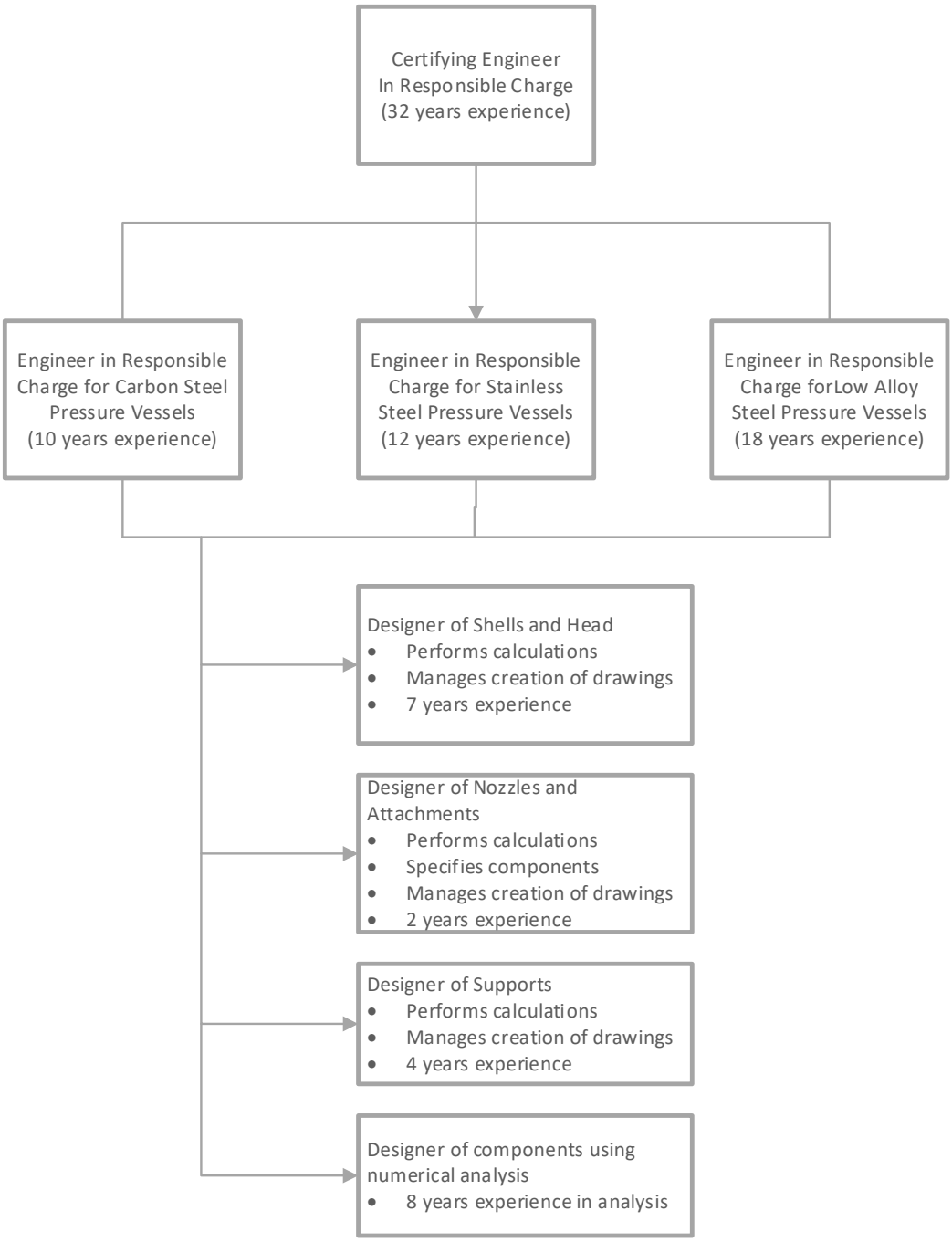
during monitoring of the Quality Control System and available to ASME Joint Review Teams. [References – UG-91 (b); UG-117 (e) & (f); and Mandatory Appendix 10)

- 47-4 is intended to cover other individuals engaged in pressure vessel design while under the responsible charge of another individual
    - 47-4(b) is intended to recommend an individual maintain clear, objective evidence of experiences obtained for pressure vessel design. A recommended form is provided.
    - 47-4(c) is intended to indicate an individual may perform design activities as required while under the responsible charge of another individual
- 47-5 lists explicit design activities requiring either a Certifying engineer or additional qualifications of the engineer or designer. This list mirrors the design activities located in Section VIII, Division 2, Annex 2-J.
    - 47-5(a) clearly states a Certifying engineer may engage in the activities. This is based on the overall requirement that Certifying engineers must attest to their qualifications, and are, by most jurisdictions, only permitted to practice engineering where they hold competence.
    - 47-5(b) addresses the additional qualifications necessary for engineers or designers to conduct numerical analysis or fatigue analysis. It also addresses performing seismic reactions, quick actuating closures, or designs under U-2(g).
- 47-6 identifies the Manufacturer's responsibilities relative to this Appendix.
    - 47-6(b) provides a recommended body of knowledge necessary for the person in responsible charge. This information is taken from The National Society of Professional Engineers, Engineering Body of Knowledge (BOK), first edition, 2013.

## Appendix 47 Example 1

A Manufacturer has several lines of products and size ranges. The Manufacturer shop fabricates complex pressure vessels up to 10 meters diameter and/or 100 meters long. The Manufacturer forms their own heads and can post weld heat treat on site. The Manufacturer fabricates pressure vessels using carbon steel, stainless steel and low alloy steel.

This Manufacturer may have a design organization complying with 47-2 as follows:



## Appendix 47 Example 2

A Manufacturer has several lines of products and size ranges. The Manufacturer shop fabricates ordinary pressure vessels up to 2 meters diameter and/or 10 meters long. The Manufacturer purchases formed heads and has no products that require post weld heat treatment. The Manufacturer fabricates pressure vessels using carbon steel only. There are no pressure vessels designed for cyclic or fatigue service.

This Manufacturer may have a design organization as follows: