ASME PTB-4-2021

ASME Section VIII
Division 1
Example Problem Manual

ASME
SETTING THE STANDARD

PTB-4-2021

ASME Section VIII – Division 1 Example Problem Manual

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Date of Issuance: January 15, 2022

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990
ISBN No. 9780791875070

FOREWORD TO THE THIRD EDITION

This document is the third edition of the ASME Section VIII – Division 1 Example Problem Manual. The purpose of this third edition is to update the example problems to keep current with the changes incorporated into the 2021 edition of the ASME B&PV Code, Section VIII, Division 1. The example problems included in the second edition of the manual were based on the contents of the 2013 edition of the B&PV Code.

Known corrections to paragraph changes and references, design equations, and calculation results have been made in this third edition. Additionally, some formatting modifications were made to facilitate better use of the example manual, as applicable.

FOREWORD TO THE SECOND EDITION

This document is the second edition of the ASME Section VIII – Division 1 example problem manual. The purpose of this second edition is to update the example problems to keep current with the changes incorporated into the 2013 edition of the ASME B&PV Code, Section VIII, Division 1. The example problems included in the first edition of the manual were based on the contents of the 2010 edition of the B&PV Code. In 2011, ASME transitioned to a two year publishing cycle for the B&PV Code without the release of addenda. The release of the 2011 addenda to the 2010 edition was the last addenda published by ASME and numerous changes to the Code were since adopted.

This second edition of the example manual includes two new sections covering examples for tube–to–tubesheet welds and required markings of pressure vessel nameplates. Known corrections to design equations and results have also been made in this second edition. Additionally, some formatting modifications were made to facilitate better use of the example manual, as applicable.

FOREWORD

This document is the Division 1 Example Problem Manual. In this manual, example problems are solved using both the Division 1 and Division 2 rules. When the design rule is the same, the example problem is solved using the Division 2 rules with the Division 1 allowable stress and weld joint efficiency. With this approach, users of Division 1 will become familiar and adept at using Division 2, and this will also provide a significant training benefit to the Division 1 user in that Division 2 has been designed as the home for the common rules' initiative being undertaken by the ASME Section VIII Committee.

In 2007, ASME released a new version of the ASME B&PV Code, Section VIII, Division 2. This new version of Division 2 incorporated the latest technologies to enhance competitiveness and is structured in a way to make it more user-friendly for both users and the committees that maintain it. In addition to updating many of the design-by-analysis technologies, the design-by-rule technologies, many adopted from the Division 1 rules, were modernized. ASME has issued *ASME Section VIII – Division 2 Criteria and Commentary, PTB-2-2009* that provides background and insight into design-by-analysis and design-by-rule technologies.

The ASME Section VIII Committee is currently undertaking an effort to review and identify common rules contained in the Section VIII Division 1, Division 2, and Division 3 B&PV Codes. In this context, common rules are defined as those rules in the Section VIII, Division 1, Division 2, and Division 3 Codes that are identical and difficult to maintain because they are computationally or editorially complex, or they require frequent updating because of the introduction of new technologies. Common rules typically occur in the design-by-rule and design-by-analysis parts of the code; but also exist in material, fabrication, and examination requirements. A plan has been developed to coordinate common rules with the following objectives.

- Common rules in the Section VIII Division 1, 2, and 3 codes should be identical and updated at the same time to ensure consistency.
- Common rules will be identified and published in a single document and referenced by other documents to; promote user-friendliness, minimize volunteer time on maintenance activities, and increase volunteer time for incorporation of new technologies to keep the Section VIII codes competitive and to facilitate publication.
- Core rules for basic vessel design such as wall thickness for shells and formed heads, nozzle design, etc. will be maintained in Division 1; although different from Division 2 these rules are time-proven and should remain in Division1 because they provide sufficient design requirements for many vessels.
- ASME Section VIII Committee recognizes that Division 2 is the most technically advanced and best organized for referencing from the other Divisions and recommends that, with the exception of overpressure protection requirements, common rules identified by the committee shall reside in Division 2 and be referenced from Division 1 and Division 3, as applicable.

As a starting point for the common rules' initiative, the ASME Section VIII Committee has developed Code Case 2695 to permit the use of some the design-by-rule procedures in Division 2 to be used for Division 1 construction.

As part of the common rules' initiative, the ASME Section VIII Committee is working with ASME LLC to create separate example problem manuals for each Division. These manuals will contain problem examples that illustrate the proper use of code rules in design. The *ASME Section VIII - Division 2 Example Problem Manual, PTB-3 2009* has been completed and issued.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the following individuals for their thoughtful review and comments of technical matters, their assistance with administrative tasks and for the overall development of the 2021 Edition of PTB-4 ASME Section VIII - Division 1 Example Problem Manual.

ASME Peer Review Group: Richard Basile, Steven Roberts, Thomas Pastor, Jay Vattappilly, Kang Xu, Dale Swanson, Mark Lower, Gabriel Aurioles, Ramsey Mahadeen, Frank Richter, George Rawls, Susumu Terada, Clay Rodery, Benjamin Hantz, Scott Mayeux, Chris Hinson, Walter Beach, and Maan Jawad.

Subgroup Heat Transfer Equipment, especially Anne Chaudouet, Samantha Neilsen, and Michael Clark.

ASME PTCS Project Engineer, Erika Lawson, and ST-LLC Specialist, Selin Sahici.

The author would also like to commend the efforts of Tiffany Shaughnessy for documentation control and preparation efforts in the publication of this manual.

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PART 1

GENERAL REQUIREMENTS

1.1 Introduction

ASME B&PV Code, Section VIII, Division 1 contains mandatory requirements, specific prohibitions, and non-mandatory guidance for the design, materials, fabrication, examination, inspection, testing, and certification of pressure vessels and their associated pressure relief devices.

1.2 Scope

Example problems illustrating the use of the design-by-rule methods in ASME B&PV Code, Section VIII, Division 1 are provided in this document. Example problems are provided for most of the calculation procedures in either SI or US Customary units.

1.3 Definitions

The following definitions are used in this manual.

1) VIII-1 – ASME B&PV Code, Section VIII, Division 1, 2021

2) VIII-2 – ASME B&PV Code, Section VIII, Division 2, 2021

1.4 Organization and Use

An introduction to the example problems in this document is described in Part 2 of this document. The remaining Parts of this document contain the example problems. All paragraph references without a code designation, i.e., VIII-1 or VIII-2, see References, are to the ASME B&PV Code, Section VIII, Division 1, 2021 [1], or the ASME B&PV Code, Section VIII, Division 1, 2021 [2], respectively.

The example problems in this manual follow the design by rule methods in ASME B&PV Code, Section VIII, Division 1. Many of the example problems are also solved using ASME B&PV Code, Section VIII, Division 2 design-by-rule procedures contained in Part 4 of this Code using the allowable stress from VIII-1. In addition, where the design rules are the same, the VIII-2 format has been used in this example problem manual because of the user-friendliness of these rules.