

ASME PTB-3-2010

ASME
Section VIII – Division 2
Example Problem Manual

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**ASME Section VIII - Division 2
Example Problem Manual**

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FOREWORD

In 1998 the ASME Boiler and Pressure Vessel Standards Committee authorized a project to rewrite the ASME B&PV Code, Section VIII, Division 2. This decision was made shortly after the design margin on specified minimum tensile strength was lowered from 4.0 to 3.5 in Section I and Section VIII, Division 1. ASME saw the need to update Section VIII, Division 2 to incorporate the latest technologies and to be more competitive. In lieu of revising the existing standard, the decision was made to perform a clean sheet rewrite. By doing so it was felt that, not only could the standard be modernized with regard to the latest technical advances in pressure vessel construction, but it could be structured in a way to make it more user-friendly for both users and the committees that maintain it.

Much new ground was broken in the development of the new Section VIII, Division 2, including the process taken to write the new standard. Traditionally, development of new standards by ASME is carried out by volunteers who serve on the different committees responsible for any given standard. Depending upon the complexity of the standard, the development of the first drafts may take up to 15 years to complete based on past history. The prospect of taking 15 or more years to develop VIII-2 was unacceptable to ASME and the volunteer leadership. The decision was made to subcontract the development of the draft to the Pressure Vessel Research Council (PVRC) who in turn formed the Task Group on Continued Modernization of Codes to oversee the development of the new Section VIII, Division 2 Code. PVRC utilized professionals with both engineering and technical writing expertise to develop new technology and the initial drafts of the new Section VIII, Division 2.

A Steering Committee made up of ASME Subcommittee VIII members was formed to provide technical oversight and direction to the development team with the goal of facilitating the eventual balloting and approval process. ASME also retained a Project Manager to manage all the activities required to bring this new standard to publication.

The project began with the development of a detailed table of contents containing every paragraph heading that would appear in the new standard and identifying the source for the content that would be placed in this paragraph. In preparing such a detailed table of contents, the lead authors were able to quickly identify areas where major development effort was required to produce updated rules. A list of some of the new technology produced for VIII-2 rewrite includes:

- Adoption of a design margin on specified minimum tensile strength of 2.4,
- Toughness requirements,
- Design-by-rule for the creep range,
- Conical transition reinforcement requirements,
- Opening reinforcement rules,
- Local strain criteria for design-by-analysis using elastic-plastic analysis,
- Limit load and plastic collapse analysis for multiple loading conditions,
- Fatigue design for welded joints based on structural stress method, and
- Ultrasonic examination in lieu of radiographic examination.

Users of the Section VIII, Division 2 Code (manufacturers and owner/operators) were surveyed at the beginning of the project to identify enhancements that they felt the industry wanted and would lead to increased use of the standard. Since the initial focus of the Code was for the construction of pressure equipment for the chemical and petrochemical industry, the people responsible for specifying equipment for this sector were very much interested in seeing that common requirements that are routinely found in vessel specifications would become a requirement within this standard. This was accomplished by close participation of the petrochemical industry during the development of this standard. Some of the enhancements included:

- Alternatives provided for U.S. and Canadian Registered Professional Engineer certification of the User Design Specification and Manufacturers Design Report,
- Consolidation of weld joint details and design requirements,
- Introduction of a weld joint efficiency and the use of partial radiographic and ultrasonic examination,
- Introduction of the concept of a Maximum Allowable Working Pressure (MAWP) identical to VIII-1,
- Significant upgrade to the design-by-rule and design-by-analysis procedures,
- Extension of the time-independent range for low chrome alloys used in heavy wall vessels,
- Extension of fatigue rules to 900°F (400°C) for low-chrome alloys used in heavy wall vessels,
- Adoption of new examination requirements and simplification of presentation of the rules,
- User-friendly extensive use of equations, tables, and figures to define rules and procedures, and
- ISO format; logical paragraph numbering system and single column format
- Many of these enhancements identified by users were included in the first release of Section VIII, Division 2 in 2007.

After publication of Section VIII, Division 2, ASME contracted with the Equity Engineering Group, Inc. to develop the ASME Section VIII, Division 2 Example Problem Manual. This publication is provided to illustrate the design calculations used in the ASME B&PV Code, Section VIII, Division 2.

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PART 1

GENERAL REQUIREMENTS

PART CONTENTS

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1.1 Introduction

ASME B&PV Code, Section VIII, Division 2 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. The 2007 edition of the code has been re-written and reorganized, and incorporates the latest technologies for pressure vessel design.

1.2 Scope

Example problems illustrating the use of the design-by-rule and design-by-analysis methods in ASME B&PV Code, Section VIII, Division 2 are provided in this document. Example problems are provided for all calculation procedures in both SI and US Customary units.

1.3 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. The Parts 3, 4, and 5 in this document coincide with the Parts 3, 4 and 5 in the ASME B&PV Code, Section VIII, Division 2. For example, example problems illustrating the design-by-rule calculations contained in Part 4 of Section VIII, Division 2 are provided in Part 4 of this document. All paragraph references are to the ASME B&PV Code, Section VIII, Division 2 2007 with the 2009 Addenda [1].

The example problems in this manual follow the calculation procedures in ASME B&PV Code, Section VIII, Division 2. It is recommended that users of this manual obtain a copy of ASME PTB-1-2009 [2] that contains criteria and commentary on the use of the design rules.

It should be noted that VIII-2 permits the use of API 579-1/ASME FFS-1 [3] for some calculation procedures. When reviewing certain example problems in this manual, it is recommended that users obtain a copy of this standard.