



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 4732.5-2024

**Pressure vessels design by analysis - Part 5: Elastic plastic
analysis method**

压力容器分析设计 第5部分：弹塑性分析法

Issued on: July 24, 2024

Implemented on: July 24, 2024

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for standardization work Part

1. Structure and drafting rules for standardization documents" Drafting. This document is part 5 of GB/T 4732 "Analysis and Design of Pressure Vessels". GB/T 4732 has been published in the following parts.

1. General requirements;

3. Formula method;

4. Stress classification method;

5. Elastic-plastic analysis methods;

6. Manufacturing, inspection and acceptance. Please note that some of the contents of this document may involve patents. The issuing organization of this document does not assume the responsibility for identifying patents. This document is proposed and coordinated by the National Technical Committee for Standardization of Boilers and Pressure Vessels (SAC/TC262). This document was drafted by: China Special Equipment Testing and Research Institute, Zhejiang University, Tsinghua University, Shanghai University of Technology, Beijing University of Chemical Technology, China Beijing Branch of China Huanqiu Engineering Co., Ltd., Hefei General Machinery Research Institute Co., Ltd., Sinopec Engineering Construction Co., Ltd., Tianjin Institute of University of Technology. The main drafters of this document are: Chen Zhiwei, Zheng Jinyang, Lu Mingwan, Liu Yinghua, Yang Guoyi, Su Wenxian, Duan Chenghong, Yang Jie, Nie Defu, Shen Yun, Li Keming, Huang Yongli, and Li Tao.

GB/T 4732 "Analysis and Design of Pressure Vessels" provides the requirements for the construction of pressure vessels according to the analysis and design method. GB/T 150 is based on The rule design concept puts forward the requirements for the construction of pressure vessels. Pressure vessel design and manufacturing units can choose two construction methods according to the specific design conditions. One of the standards implements the construction of pressure vessels. GB/T 4732 consists of 6 parts.

1.General requirements. The purpose is to provide general requirements for pressure vessels built according to analysis and design, including relevant management requirements. Requirements, common terms and definitions, and basic requirements shared by other parts of GB/T 4732.

2.Materials. The purpose is to give the relevant requirements and material properties of steel materials in pressure vessels built according to analysis and design. Energy data, etc.

3.Formula method. The purpose is to give typical pressure components and structural design requirements of pressure vessels built according to analytical design. The thickness calculation formulas for commonly used container parts designed by the formula method are specifically given. GB/T 4732.3 can be used as The design basis of GB/T 4732.4 and GB/T 4732.5 can also be simplified and completed according to GB/T 4732.3. Analysis design.

4.Stress classification method. The purpose is to give the stress classification method used in pressure vessels built according to analysis and design. Design related regulations.

5.Elastic-plastic analysis method. The purpose is to give the elastic-plastic analysis method used in pressure vessels built according to analytical design. Relevant provisions for design in accordance with the law.

6.Manufacturing, inspection and acceptance. The purpose is to give the structural types of pressure vessels built according to analysis and design. Manufacturing, inspection and acceptance requirements for devices. GB/T 4732 includes the pressure vessel construction process based on the analysis and design method (i.e. materials, design, manufacturing, inspection, testing and verification). GB/T 4732 does not need to and cannot cover all the technical requirements and special prohibition regulations that need to be followed in the collection work. All technical details of the pressure vessel construction, therefore, under the premise of meeting the basic safety requirements specified in the safety technical specifications, there is no restriction There is no special mention of technical content in GB/T 4732.GB/T 4732 cannot be used as a technical manual for the construction of specific pressure vessels, nor can it be used as a technical manual for the construction of specific pressure vessels. Alternative training, engineering experience and engineering evaluation. An engineering evaluation is a review of a specific Technical evaluation of products. Engineering evaluation needs to comply with the relevant technical requirements of GB/T 4732. GB/T 4732 does not restrict the use of other advanced technical methods in actual

engineering construction, but engineering and technical personnel use advanced technical methods. Reliable judgment is needed when applying the law to ensure that it meets the requirements of GB/T 4732. GB/T 4732 neither requires nor restricts designers to use computer programs to analyze and design pressure vessels, but the use of computers is. When analyzing and designing the program, in addition to meeting the requirements of GB/T 4732, it is also necessary to confirm.

1 Scope

GB/T 4732.5-2024 specifies the elastic-plastic analysis route of the Chinese design-by-analysis pressure vessel series, the method used where stress classification cannot be trusted: thick-walled structures, geometries with severe discontinuities, and any case where the vessel is expected to yield locally by design. Instead of sorting elastic stresses into categories, it evaluates the structure directly against each failure mode with an analysis that models plasticity. The part sets the terms and symbols, the basic requirements and the load combination conditions, and then gives the evaluation procedure for five failure modes in turn: plastic collapse, excessive local strain, buckling, fatigue and ratcheting. Its normative annexes carry the design-by-analysis approach for high-temperature creep, the dual evaluation criterion for plastic collapse and the direct computation method for limit, shakedown and ratchet boundaries, which is the modern alternative to cyclic step-by-step analysis. It applies to the pressure vessels defined in GB/T 4732.1-2024, and for a designer using finite element analysis on Chinese vessels this is the governing text.

This document specifies the analysis and design method of pressure vessels based on elastic-plastic theory, including terminology and symbols, basic requirements, load combination technology, The evaluation steps for five failure modes are as follows: plastic collapse, local overstrain, buckling, fatigue and ratcheting. This document applies to pressure vessels covered by GB/T 4732.1-2024.

2 Normative references

The contents of the following documents constitute essential clauses of this document through normative references in this document. For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to This document.

GB/T 4732.1-2024 Analysis and design of pressure vessels Part

3 Formula method

GB/T 4732.4-2024 Analysis and design of pressure vessels Part

3.1 Terms and Definitions The terms and definitions defined in

GB/T 4732.1-2024 and the following apply to this document.

3.1.1 Forming strain formingstrain Residual strains caused by component forming.

3.1.2 Uniaxial strain limit uniaxialstrainlimit The strain limit of a material under uniaxial stress.

3.1.3 triaxial strain limit The strain limit of a material under triaxial stress state.

3.1.4 twiceyieldmethod The cyclic stress-strain curve is expressed by using zero as the starting load and the load range as the end load, and the stress range-strain range is used. Fatigue assessment method for elastic-plastic analysis under adjustable loading conditions.

3.1.5 cycle-by-cycleanalysismethod Based on the kinematic hardening model, the cyclic stress-strain curve represented by stress amplitude-strain amplitude is used to perform elastic tests on the given load cycles one by one.

4 Stress classification method

GB/T 4732.6-2024 Pressure vessel analysis and design Part