

ASME PCC-2-2018
(Revision of ASME PCC-2-2015)

Repair of Pressure Equipment and Piping

AN AMERICAN NATIONAL STANDARD



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FOREWORD

ASME formed an Ad Hoc Task Group on Post-Construction in 1993 in response to an increased need for recognized and generally accepted engineering standards for the inspection and maintenance of pressure equipment after it has been placed in service. At the recommendation of this Task Group, the Board on Pressure Technology Codes and Standards (BPTCS) formed the Post-Construction Committee (PCC) in 1995. The scope of this committee was to develop and maintain standards addressing common issues and technologies related to post-construction activities and to work with other consensus committees in the development of separate, product-specific codes and standards addressing issues encountered after initial construction for equipment and piping covered by Pressure Technology Codes and Standards. The BPTCS covers non-nuclear boilers, pressure vessels (including heat exchangers), piping and piping components, pipelines, and storage tanks.

The requirements and recommendations established by the Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design or repair method, or as limiting in any way the freedom to choose any method of design or any form of repair that conforms to these requirements and recommendations.

The Committee meets regularly to consider revisions, to develop new requirements and recommendations as dictated by technological development, Cases of the PCC Standards, and requests for interpretations. Only the Committee has the authority to provide official interpretations of these Standards. Requests for revisions, new rules, Cases of the PCC Standards, or interpretations shall be addressed to the Secretary in writing and shall give full particulars in order to receive consideration and action (see Correspondence With the PCC Committee). Proposed revisions to the Standard resulting from inquiries will be presented to the Committee for appropriate action. The action of the Committee becomes effective only after confirmation by ballot of the Committee and approval by ASME. Proposed revisions to the Standards approved by the Committee are submitted to the American National Standards Institute (ANSI) and published at <http://go.asme.org/BPVCPublicReview> to invite comments from all interested persons. After public review and final approval by ASME, revisions are published in the next scheduled edition of the Standard.

The PCC selects standards to be developed based on identified needs and the availability of volunteers. The PCC formed the Subcommittee on Inspection Planning and the Subcommittee on Flaw Evaluations in 1995. In 1998, a Task Group under the PCC began preparing Guidelines for Pressure Boundary Bolted Flange Joint Assembly. In 1999, the PCC formed the Subcommittee on Repair and Testing. In 2002, the Subcommittee on Flaw Evaluation was dissolved and replaced by the Joint ASME/API Committee on Fitness for Service. Other topics are under consideration and may be developed into future guideline documents.

The subcommittees were charged with preparing standards dealing with several aspects of the in-service inspection and maintenance of pressure equipment and piping. The Inspection Planning Standard provides guidance on the preparation of a risk-based inspection plan. Defects that are identified are then evaluated, when appropriate, using the procedures provided in the Fitness for Service. Finally, if it is determined that repairs are required, guidance on repair procedures is provided in the Repair of Pressure Equipment and Piping Standard.

None of these documents are codes. They provide recognized and generally accepted good practices that may be used in conjunction with Post-Construction Codes, such as API 510, API 570, and NB-23, and with jurisdictional requirements.

The first edition of ASME PCC-1, *Guidelines for Pressure Boundary Bolted Flange Joint Assembly*, was approved for publication in 2000. ASME PCC-1-2000 was approved by the American National Standards Institute (ANSI) as an American National Standard on November 15, 2000.

The first edition of ASME PCC-3, *Inspection Planning Using Risk-Based Methods*, was approved for publication in 2007. It was approved by ANSI as an American National Standard on October 4, 2007.

The first edition of ASME PCC-2, *Repair of Pressure Equipment and Piping*, was approved for publication in 2004. Subsequent editions were published in 2008, 2011, and 2015.

Starting with this 2018 edition, new editions are expected to be published on a four-year cycle. ASME PCC-2-2018 was approved by ANSI as an American National Standard on August 8, 2018.

ASME PRESSURE TECHNOLOGY POST-CONSTRUCTION COMMITTEE

(The following is the roster of the Committee at the time of approval of this Standard.)

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CORRESPONDENCE WITH THE PCC COMMITTEE

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, PCC Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
<http://go.asme.org/Inquiry>

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the PCC Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the PCC Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at <http://go.asme.org/InterpretationRequest>. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the PCC Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

Attending Committee Meetings. The PCC Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the PCC Standards Committee.

ASME PCC-2-2018 SUMMARY OF CHANGES

Following approval by the ASME PCC Committee and ASME, and after public review, ASME PCC-2-2018 was approved by the American National Standards Institute on August 8, 2018.

ASME PCC-2-2018 includes the following changes identified by a margin note, **(18)**. In addition, articles and all associated appendices have been redesignated with a new identifying article number. Paragraphs now carry that unique number as a prefix, with the figures and tables identified with the specific paragraph number to which they belong. For example, Figure 1 in former Article 2.1 is now designated as Figure 201-3.5-1.

<i>Page</i>	<i>Location</i>	<i>Change</i>
xv	Foreword	Updated and second paragraph added
xviii	Correspondence With the PCC Committee	Former "Preparation of Technical Inquiries" replaced with "Correspondence With the PCC Committee"
1	101-1	First sentence revised and third paragraph added
1	101-2	(1) Subparagraph (a) revised (2) Former Table 1 deleted
2	101-3.4	Revised in its entirety
2	101-3.7	Second and third sentences revised
4	201-3.8	Subparagraph (b) revised
5	Figure 201-3.8-1	Note (5) revised
6	Figure 201-3.8-2	Note (5) revised
15	202-7	Updated
16	203-1.1	First sentence revised
16	203-1.3	Fourth sentence revised
16	203-2.3	Second sentence revised
17	203-5	Revised in its entirety
18	203-7	Updated
23	Article 205	Added
29	Figure 206-1.1.1-1	Callouts "Carrier pipe" and "Groove weld optional" added
30	Figure 206-1.1.2-1	Callout "Carrier pipe" added
29	206-2.10	Title revised
29	206-3.2	Revised
30	206-3.5	Subparagraph (b) revised
32	Figure 206-3.5-1	Revised
32	Figure 206-3.5-2	Revised
33	206-4.6	First sentence revised
33	206-4.7	Title and paragraph revised
33	206-5.3	Revised
33	206-5.5	Revised
33	206-6	Revised

33	206-7	Updated
37	207-3.2	In nomenclature below eq. (1), unit of measure for P revised
40	207-7	Updated
44	208-7	Updated
49	209-7	Updated
58	210-7	Updated
67	211-7	Updated
70	212-3.2	In nomenclature below eq. (1), unit of measure for P revised
71	212-3.4	Equation (4) revised
72	212-7	Updated
75	213-7	Updated
81	214-7	Updated
85	Article 215	Former Article 2.15 published in ASME PCC-2S-2015, incorporated into PCC-2 and revised editorially
	215-7	Updated
96	Article 216	Added
109	301-7	Updated
118	303-7	Updated
129	304-7	Updated
135	305-7.1	Updated
139	306-7	Updated
141	307-5.1.2	Editorially revised
142	307-7	Updated
144	308-3.1	Editorially revised
149	308-7	Updated
157	311-7	Updated
165	312-7	Updated
170	Article 313	Added
175	Article 401	Revised in its entirety
192	Mandatory Appendix 401-I	In the Component Repair Data Sheet, under Risk Assessment, Repair type revised
195	401-II-1	Subparagraph (b) revised
195	401-II-2	Subparagraphs (h) and (i) revised
195	401-II-3	Revised
197	401-III-2	Subparagraph (a) revised
199	401-IV-3	In subpara. (c), equations numbered and subsequent equations in subparas. (d) and (e) renumbered
201	401-V-2.1	Subparagraphs (e) and (f) revised
201	401-V-2.2	Subparagraph (f) revised
202	401-V-2.3	Subparagraphs (e) and (f) revised
204	401-VII-1	Last sentence above Note revised
204	401-VII-2	Subparagraph (a)(1) revised
205	401-VII-4	Subparagraph (d) revised
206	401-VIII-5	Subparagraph (e)(5) revised
208	401-A-1	Definition of <i>batch</i> added
209	401-A-2	Revised

210	401-B-1	Revised
210	401-B-3	Revised in its entirety
212	Table 401-B-2-1	Table and General Note revised
213	Article 402	Revised
221	Mandatory Appendix 402-I	In Repair Data Sheet, under Repair Requirements, Repair type revised
223	Mandatory Appendix 402-II	Revised in its entirety
224	402-III-2	Subparagraph (c) revised and subparas. (d) through (f) added
225	Mandatory Appendix 402-IV	Revised in its entirety
226	402-V-2	Subparagraph (d) revised and subpara. (e) added
226	402-V-3	Subparagraph (c) revised
226	402-V-5	Revised
227	402-A-1	Definition of <i>batch</i> added
227	402-A-2	Revised
229	Article 403	(1) 403-1, 403-2, and 403-3 editorially revised (2) New 403-4.3 added and subsequent paragraph redesignated as 403-4.4 and editorially revised (3) 403-7 updated
241	Mandatory Appendix 403-III	(1) Definition of <i>batch</i> added (2) Definition of <i>epoxies</i> and <i>thermoset polymer</i> editorially revised (3) 403-III-2 editorially revised
242	501-1	Revised
242	501-2	Revised
242	501-3.2	Subparagraph (d) revised
243	501-3.4.3	Revised
245	501-6.1	Editorially revised
247	501-6.2	Revised
249	501-6.2.1	Editorially revised
250	501-7	Updated
251	Mandatory Appendix 501-I	Editorially revised
253	Mandatory Appendix 501-II	Revised
256	Mandatory Appendix 501-IV	Revised in its entirety
258	502-1.5.1	Editorially revised
258	502-1.6	Editorially revised
259	502-1.7	Editorially revised
260	502-7	Updated
264	Article 503	Added

PART 1

SCOPE, ORGANIZATION, AND INTENT

Article 101

Introduction

(18) **101-1 SCOPE**

This Standard provides methods for repair of equipment, piping, pipelines, and associated ancillary equipment within the scope of ASME Pressure Technology Codes and Standards¹ after they have been placed in service. These repair methods include relevant design, fabrication, examination, and testing practices and may be temporary or permanent, depending on the circumstances.

The methods provided in this Standard address the repair of components when repair is deemed necessary based on appropriate inspection and flaw assessment. These inspection and flaw evaluation methods are not covered in this Standard, but are covered in other post-construction codes and standards.

This Standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this Standard to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.

Only technical procedures and information are provided; administrative or policy requirements are outside of the scope of this Standard.

(18) **101-2 ORGANIZATION**

This Standard is divided into five Parts.

(a) **Part 1** covers the scope, organization, and intent and is applicable to all articles in this Standard.

(b) **Part 2** covers repair methods and techniques that include the use of welding, brazing, soldering, or other methods involving metal deposit.

(c) **Part 3** covers mechanical repairs, with or without sealant, such as bolted clamps or fixtures and includes all repair methods not covered in **Part 2** or **Part 4**.

(d) **Part 4** covers repairs using nonmetallic means, such as nonmetallic liners and wraps, and bonding (e.g., joining by epoxy), including bonding of metallic components.

¹ Equipment and piping within the scope of ASME Pressure Technology Codes and Standards includes piping (including pipelines) and piping components (such as valves), boilers, pressure vessels (including heat exchangers), and storage tanks.

(e) **Part 5** covers examination and testing methods and techniques.

101-3 INTENT

101-3.1 General

This Standard provides technical information, procedures, and recommendations for repair methods that were determined by consensus to be recognized and generally accepted good engineering practice. Where equipment repair is subject to jurisdictional regulation, jurisdictional approvals may be required.

101-3.2 Definitions

The words *may*, *shall*, and *should* are used in the repair articles of PCC-2 and they have the following intent:

may: indicates an action that is permitted, but not required.

shall: an action that is mandatory. It indicates an action that is an essential element of the repair method that cannot be eliminated.

should: an action that is not mandatory. It indicates an action that when performed, is generally considered to be good practice; however, there are some circumstances when the action is not appropriate or required, so the word *should* is used to provide flexibility for the article to cover a broad range of circumstances. It is not mandatory unless so specified by others in the application of these articles.

101-3.3 Administrative Requirements

For administrative requirements such as inspection, documentation, and quality control, the user is referred to an applicable post-construction code and to the jurisdictional requirements. In the absence of an applicable post-construction code or jurisdictional requirements, the owner of the pressure equipment or piping should establish the administrative requirements. A post-construction code is one that provides requirements and guidance for inspection and/or repair of equipment

after it has been placed in service, and may include the references to the original construction code. Examples of post-construction codes include NB-23, API 510, API 570, and API 653.

(18) **101-3.4 Application**

(a) Users of the articles contained in this Standard are cautioned that these articles have been developed generically and are recommended for general applications. They may not necessarily be suitable for all applications. Precautionary considerations are provided, but should not be considered all inclusive. Sound *engineering practices and judgment* should be used to determine the applicability of a specific method or part of a method to a specific application. The phrase *engineering practices and judgment* refers to technical judgments made by knowledgeable engineers or subject-matter experts experienced in the application of repair practices. *Engineering judgments* shall be consistent with good engineering practices, and such judgments shall never be used to overrule mandatory requirements or specific prohibitions of this Standard. Each repair should be subject to an appropriate review by qualified personnel, and this review should consider subsequent deterioration of the repaired component.

(b) Additional limitations and considerations are contained in section 2 of the individual articles.

(c) The repair methods provided in the articles in this Standard are applicable to a variety of damage mechanisms. Examples of damage mechanisms may be found in API Recommended Practice 571. Other applications of repair for damage mechanisms are provided for in individual articles.

101-3.5 Alternative Use

While this Standard covers repair of equipment within the scope of ASME Pressure Technology Codes and Standards, it may be used on equipment constructed in accordance with other Codes and Standards.

101-3.6 Articles' Independence

Individual articles in this Standard may be used independently of other articles, except when otherwise noted. However, this Part (Part 1) applies to all articles in this Standard.

(18) **101-3.7 Repair Life**

Many of the repair techniques included in this Standard are considered to be permanent, intended to remain in place for the life of the repaired component. Others may only be suitable for short-term service, and should be replaced with a more permanent repair at

an appropriate opportunity. The anticipated life of a repair depends on many circumstances, and could include consideration of risk. As such, this Standard does not classify repair methods as permanent or temporary. Rather, technical considerations that affect the expected life of the repair are stated in the individual articles.

101-3.8 Code References

Reference to specific codes is generally avoided in this Standard because the equipment or piping could have been constructed in accordance with a number of different codes. Where such a reference is provided, it is generally the intent to include, by reference, a specific technical provision.

101-3.9 Welding

Requirements for welding, including qualification of welding procedures, welders, and welding operators should generally follow an applicable construction code or post-construction code, except when otherwise specified herein.

101-3.10 Allowable Stress

Calculations involving the allowable stress use the allowable stress from the original construction code or post-construction code, unless otherwise specified in specific articles.

101-3.11 Examination

When qualifications of examiners, methods of examination, extent of examination, and acceptance criteria are not specified, they should follow the requirements of an applicable construction code or post-construction code.

101-3.12 Records

The owner should keep records that document the repair. Specific requirements for documentation are not provided in this Standard. The owner should retain records that comply with applicable jurisdictional and post-construction code requirements. Documentation may include such items as a description of the condition that required attention and its cause, repair procedures that were used, photos prior to and after the repair, examination procedures and records, heat treatment records, test records, and the names of the persons/firms performing the repair and examination and their certification. The documentation forms part of the history of the pressure component and should be retained as long as it is relevant.