ASME QME-1–2023
(Revision of ASME QME-1–2017)

# Qualification of Active Mechanical Equipment Used in Nuclear Facilities

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The endnotes and preamble in this document (if any) are part of this American National Standard.

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# FOREWORD

Federal regulations applicable to nuclear power plants require that measures be established to ensure that certain equipment operates as specified. This Standard sets forth requirements and guidelines that may be used to ensure that active mechanical equipment is qualified for specified service conditions. As determined by federal regulators and/or nuclear power plant licensees, this Standard may be applied to future nuclear power plants or existing operating nuclear power plant component replacements, modifications, or additions.

In the early 1970s, initial development of qualification standards was assigned to the N45 Committee of the American National Standards Institute (ANSI). The N45 Committee in turn established a task force to prepare two series of standards to ensure that pumps and valves used in nuclear plant systems would function as specified. The N45 Committee's valve task force (N278) was reassigned in 1974 to the American National Standards Committee B16 and designated Subcommittee H. The first qualification standard to be issued for valves was ANSI N278.1-1975, which covered the preparation of functional specifications. In 1982, the task force was reassigned to The American Society of Mechanical Engineers (ASME) Committee on Qualification of Mechanical Equipment Used in Nuclear Power Plants (QME) and designated the Subcommittee on Qualification of Valve Assemblies. As an interim measure, in 1983, ANSI B16.41 was issued to cover functional qualification requirements for power-operated active valve assemblies for nuclear power plants.

The N45 Committee's pump task force (N551), established in 1973, was assigned to ASME Nuclear Power Codes and Standards along with N278 as part of the Subcommittee QNPE, Qualification of Nuclear Plant Equipment. Both N551 and N278 operated as Subcommittee QNPE until 1982, when they were reassigned to the QME Committee and designated as, respectively, the Subcommittee on Qualification of Pump Assemblies and the Subcommittee on Qualification of Valve Assemblies. In June 1977, an agreement between the Institute of Electrical and Electronics Engineers (IEEE) and ASME was formulated, giving primary responsibility for qualification standards to IEEE and for quality assurance standards to ASME. This arrangement remained in effect until ASME established the Committee on Qualification of Mechanical Equipment Used in Nuclear Power Plants, now known as the Committee on Qualification of Mechanical Equipment Used in Nuclear Facilities.

The various parts of ASME QME-1–1994 were approved by ANSI on the following dates: Section QP, September 22, 1992; Section QR, June 8, 1993; Section QR, Nonmandatory Appendix A, October 7, 1993; Section QR, Nonmandatory Appendix B, May 14, 1993; and Section QV and its Nonmandatory Appendix A, February 17, 1994. Section QV was a revision and redesignation of ANSI B16.41-1983.

ASME QME-1–2002 was published in 2003. In September 2003, it was recognized that the Standard had aspects, such as the process for valve qualification, that could better use new computer analytical techniques and that were proscriptive in nature. In addition, seismic qualification needed to be updated to recognize new industry guidance. New sections were needed on standardization of experience-based seismic equipment qualification and the qualification of dynamic restraints. At the time, industry experience had demonstrated that qualification to ASME QME-1 was required without the specification of the parameters for which equipment needed to be qualified. The use of this Standard requires that a Qualification Specification be provided.

ASME QME-1–2007 was endorsed by the Nuclear Regulatory Commission (NRC) and was the first edition of ASME QME-1 to be so endorsed. It was approved as an American National Standard on June 25, 2007.

The 2012 edition of this Standard was approved as an American National Standard on September 17, 2012.

The 2017 edition of this Standard was approved as an American National Standard on March 21, 2017.

Following approval by the ASME QME Committee, ASME QME-1–2023 was approved by ANSI as an American National Standard on January 13, 2023.

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**Revisions and Errata.** The committee processes revisions to this Standard on a continuous basis 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 in the next edition of the Standard.

In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata.

This Standard is always open for comment, and the committee welcomes proposals for revisions. 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 background information and supporting documentation.

**Cases**

*(a)* The most common applications for cases are

*(1)* to permit early implementation of a revision based on an urgent need

*(2)* to provide alternative requirements

*(3)* to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Standard

*(4)* to permit the use of a new material or process

*(b)* Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Standard.

*(c)* A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

*(1)* a statement of need and background information

*(2)* the urgency of the case (e.g., the case concerns a project that is underway or imminent)

*(3)* the Standard and the paragraph, figure, or table number(s)

*(4)* the edition(s) of the Standard to which the proposed case applies

*(d)* A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Approved cases are posted on the committee web page.

**Interpretations.** Upon request, the committee will issue an interpretation of any requirement of this Standard. An interpretation can be issued only in response to a request submitted through the online Interpretation Submittal Form at https://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic e-mail confirming receipt.

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 information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers can track the status of their requests at https://go.asme.org/Interpretations.

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# ORGANIZATION OF ASME QME-1

## 1 GENERAL

ASME QME-1 is divided into sections that are designated by capital letters: the letter "Q," which stands for *qualification,* followed by one or more letters that generally indicate the subject matter of the section. This Standard consists of four major sections as follows:

*(a)* Section QR: Qualification Requirements

*(b)* Section QDR: Qualification of Dynamic Restraints

*(c)* Section QP: Qualification of Active Pump Assemblies

*(d)* Section QV: Qualification Requirements for Active Valve Assemblies for Nuclear Facilities

## 2 SECTIONS

Sections are divided into articles, subarticles, subsubarticles, paragraphs, and, where necessary, subparagraphs and subsubparagraphs.

## 3 ARTICLES

Articles are designated by the applicable letters indicated above for the sections, followed by Arabic numbers in units of 1,000, such as QR-1000, QP-2000, or QV-6000. Whenever possible, articles dealing with the same topic are given the same number in each section in accordance with the general scheme that follows:

| Article Number | Title |
|---|---|
| 1000 | Scope |
| 2000 | Purpose |
| 3000 | References |
| 4000 | Definitions |
| 5000 | Qualification Principles and Philosophy |
| 6000 | Qualification Specification Criteria |
| 7000 | Qualification Program |
| 8000 | Documentation |

The numbering of the articles and the material contained in the articles may not, however, be consecutive. Due to the fact that the complete outline may cover phases not applicable to a particular section or article, the rules have been prepared to allow gaps in the numbering.

## 4 SUBARTICLES

Subarticles are numbered in units of 100, such as QR-7100 or QV-7200. When more than nine subarticles are required, numbering is done by paragraph and units of 1 starting with 10.

## 5 SUBSUBARTICLES

Subsubarticles are numbered in units of 10, such as QR-8310 or QR-8320.

## 6 PARAGRAPHS

Paragraphs are numbered in units of 1, such as QR-8321 or QV-8322.

## 7 SUBPARAGRAPHS

Subparagraphs, when they are major subdivisions of a paragraph, are designated by adding a decimal followed by one or more digits to the paragraph number, such as QR-8321.1 or QV-8321.2. When they are minor subdivisions of a paragraph, subparagraphs may be designated by lowercase letters in parentheses, such as QR-8321(a) or QV-8321(b).

## 8 SUBSUBPARAGRAPHS

Subsubparagraphs are designated by adding lowercase letters in parentheses to the major subparagraph numbers, such as QR-8321.1(a) or QV-8321.1(b). When further subdivisions of minor subparagraphs are necessary, subsubsubparagraphs are designated by adding Arabic numbers in parentheses to the subsubparagraph designation, such as QR-8321.1(a)(1) or QV-8321.1(a)(2).

## 9 REFERENCES (23)

References used within this Standard generally fall into one of the following three categories:

*(a) References to Other Portions of This Standard.* When a reference is made to another article, subarticle, or paragraph, all numbers subsidiary to that reference shall be included. For example, reference to QR-5000 includes all material in article QR-5000; reference to QR-7300 includes all material in subarticle QR-7300; reference to QR-7320 includes all material in subsubarticle QR-7320.

*(b) References to the Boiler and Pressure Vessel Code (ASME BPVC) and to Other Standards.* When a reference is made to any section of the BPVC, or to other standards, it

shall be understood to mean the designated article, paragraph, figure, or table in the designated document. All such references shall be identified in the text of this Standard by the document's issuing source and the document's unique identification number, e.g., ASME BPVC, Section III, Subsection NF; IEEE Std 627; or 10CFR50 Part A. If required, further reference to unique articles or paragraphs of the referenced document may also be described, e.g., ASME BPVC, Section III, Subsection NF, subpara. NF-3211.1(a). Each short reference made in the text shall be described in more complete detail in Article 3000 by issuing source, unique identification number, year of publication being referenced, and full title, e.g., IEEE Std 382-1980, Standard for Qualification of Safety Related Valve Operators. It should be noted by users of this Standard that regulatory requirements and Codes of Record for a particular nuclear power plant may take precedence over references used within this Standard. Article QR-3000 lists the references applicable for all sections.

*(c) References to Appendices.* Two types of appendix are included in this Standard, designated Mandatory and Nonmandatory. Both types of appendix are designated by the prefix Q. This is followed by letter(s), which are the same used by the section to which the appendix applies, e.g., QR. Mandatory appendices contain requirements that must be followed in qualification; such references are uniquely identified by a roman numeral, e.g., Mandatory Appendix QR-I, and its specific title. Nonmandatory appendices provide information or guidance; such references are designated by a capital letter, e.g., Nonmandatory Appendix QR-A, and its specific title.

# ASME QME-1-2023
# SUMMARY OF CHANGES

Following approval by the ASME QME Committee and ASME, and after public review, ASME QME-1–2023 was approved by the American National Standards Institute on January 13, 2023.

Throughout this Standard, the phrase "Registered Professional Engineer" has been changed to "Certifying Engineer." In addition, ASME QME-1–2023 includes the following changes identified by a margin note, **(23)**.

| *Page* | *Location* | *Change* |
|---|---|---|
| xii | Organization of ASME QME-1 | Paragraph 9(b) revised |
| 1 | QR-3000 | Updated in its entirety |
| 3 | QR-4000 | Definition of *significant aging mechanism* added |
| 5 | QR-5310 | Revised |
| 8 | QR-8000 | In QR-8200, QR-8300, QR-8400, and QR-8500, lists reformatted |
| 10 | QR-I-1120 | Revised in its entirety |
| 11 | QR-I-1300 | Added |
| 12 | QR-A-3000 | Revised |
| 15 | QR-A-5610 | Reference in last sentence updated |
| 15 | QR-A-5620 | Reference in last sentence updated |
| 21 | QR-A-7210 | Revised |
| 26 | QR-A-7500 | Added |
| 30 | QR-A-8340 | Added, and subsequent paragraph redesignated |
| 30 | QR-A-8350 | Formerly QR-A-8340, first sentence revised |
| 31 | QR-B-3000 | Revised |
| 41 | QDR-3000 | (1) Definition of *activation* revised<br>(2) Definitions of *fatigue failure* and *fatigue life* added |
| 42 | QDR-4110 | Revised |
| 43 | QDR-4210 | Revised |
| 43 | QDR-4310 | Revised |
| 43 | QDR-4410 | Revised |
| 45 | QDR-6223.1 | Subparagraphs (a), (b), and (g) revised |
| 46 | QDR-6223.2 | Subparagraphs (a), (b), (f), and (g) revised |
| 46 | QDR-6223.3 | Subparagraphs (b) and (c) revised |
| 47 | QDR-6223.4 | (1) Subparagraph (b) revised<br>(2) Subparagraphs (d) through (f) added |
| 47 | QDR-6223.4.2 | Subparagraph (a) revised |
| 47 | QDR-6224 | Revised |
| 47 | QDR-6226 | First paragraph revised |
| 52 | QDR-I-5300 | Revised |
| 53 | QDR-I-5320 | Subparagraph (f) added, and the subsequent subparagraph redesignated |

| *Page* | *Location* | *Change* |
|---|---|---|
| 53 | QDR-I-5400 | (1) Subparagraphs (a)(2) and (b)(2) revised<br>(2) Subparagraph (c)(5) added and subsequent subparagraph redesignated |
| 55 | Nonmandatory Appendix QDR-A | Revised |
| 57 | Nonmandatory Appendix QDR-B | Revised |
| 59 | QP-3000 | Revised |
| 65 | QP-8310 | In subpara. (c), cross-reference updated |
| 65 | QP-8320 | In subpara. (e), cross-reference updated |
| 79 | Table QV-7300-1 | Note (6) revised |
| 85 | QV-7561 | Last sentence added |
| 87 | QV-7660 | Last sentence added |
| 91 | QV-I-2000 | Last sentence added |
| 98 | QVG-3000 | Revised |
| 100 | QVG-6500 | Example (3) added |
| 105 | QVG-8400 | Added |
| 107 | QVG-8500 | Added |

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# Section QR
# General Requirements

## QR-1000 SCOPE

This Standard provides the requirements and guidelines for the qualification of active mechanical equipment whose function is required to ensure the safe operation or safe shutdown of a nuclear facility. In addition to requirements and guidelines put forth in this Standard, the active mechanical equipment shall comply with the requirements of the applicable design and construction codes and standards.

This Standard does not apply to electric components such as motors, electric valve actuators, instrumentation, and controls, which are qualified by conformance with appropriate IEEE standards.

## QR-2000 PURPOSE

The purpose of this Standard is to provide the requirements and recommended practices to qualify active mechanical equipment to meet specified functional requirements during operation and during or after any postulated abnormal or accident conditions.

## (23) QR-3000 REFERENCES

This article lists reference documents from which guidance, concepts, principles, practices, criteria, and parameters have been carried forward into this Standard. QR-3100 provides the industry standards and applicable editions referenced in ASME QME-1 and QR-3200 provides general reference documents used in ASME QME-1.

### QR-3100 Qualification Requirement

Table QR-3100-1 lists the current industry standards referenced by ASME QME-1 and earlier editions considered acceptable for use with ASME QME-1. It is the responsibility of the user to select an edition of an industry standard that has been accepted by the Regulatory Authority having jurisdiction over the Nuclear Facility to which the ASME QME-1 standard is to be applied.

### QR-3200 General Reference Documents

Listed below are general reference documents discussed and used in the development of this Standard.

#### QR-3210 Applicable in Mandatory Appendix QR-I

Asia-Pacific Economic Cooperation (APEC) agreement (www.apec.org)

Fédération Européenne d'Associations Nationales d'Ingénieurs (European Federation of National Engineering Associations) (FEANI) (www.feani.org)

International Professional Engineers Agreement (IPEA), formerly known as the Engineering Mobility Forum (www.ieagreements.org/agreements/ipea)

The Washington Accord (www.ieagreements.org/accords/washington)

#### QR-3220 Applicable in Nonmandatory Appendix QR-A

Advanced Light Water Reactor (ALWR) First-of-a-Kind Engineering (FOAKE) Project on Equipment Seismic Qualification, Advanced Reactor Corporation (ARC), April 1995

Publisher: U.S. Nuclear Regulatory Commission (NRC), One White Flint North, 11555 Rockville Pike, Rockville, MD 20852-2738 (www.nrc.gov)

EPRI NP-5228-V1R1, Addendum to Seismic Verification of Nuclear Plant Equipment Anchorage: Volume 1: Development of Anchorage Guidelines, Revision 1, June 30, 1994

Publisher: Electric Power Research Institute (EPRI), 3420 Hillview Avenue, Palo Alto, CA 94304 (www.epri.com)

NRC Regulatory Guide (RG) 1.60, Design Response Spectra for Seismic Design of Nuclear Power Plants, Revision 2, dated July 2014

NRC RG 1.61, Damping Values for Seismic Design of Nuclear Power Plants, Revision 1, dated March 2007

NRC Supplemental Safety Evaluation Reports on the GIP, Revision 2, Corrected 2/14/92 (SSER No. 2), the GIP, Revision 3, Updated 5/16/97 (SSER No. 3), and the GIP, Revision 3A, dated December 2001

NRC NUREG-0800, Standard Review Plan, Section 3.7.2, Seismic Systems Analysis, Revision 4, September 2013

NRC NUREG-0800, Standard Review Plan, Section 3.7.3, Seismic Subsystem Analysis, Revision 4, September 2013