ASME QME-1–2012
(Revision of ASME QME-1–2007)

Qualification of Active Mechanical Equipment Used in Nuclear Facilities

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

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ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME QME Committee may be published as Cases. Cases and interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org/ as they are issued.

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The American Society of Mechanical Engineers
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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 ANSI N45 Committee. 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 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 the Subcommittee on Qualification of Valve Assemblies and the Subcommittee on Qualification of Pump Assemblies. In June 1977, an IEEE/ASME agreement was formulated giving primary responsibility for qualification standards to IEEE and 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 the American National Standards Institute (ANSI) on the following dates: Section QP, September 22, 1992; Section QR, June 8, 1993; Section QR, Appendix A, October 7, 1993; Section QR, Appendix B, May 14, 1993; and Section QV and its Appendix A, February 17, 1994. Section QV was a revision and redesignation of ANSI B16.41-1983.

QME-1–2002 was published in 2003. In September of 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 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 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.

Requests for interpretation or suggestions for improvement of this Standard should be addressed to the Secretary of the ASME Committee on Qualification of Mechanical Equipment Used in Nuclear Facilities, The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

COMMITTEE ON QUALIFICATION OF MECHANICAL EQUIPMENT USED IN NUCLEAR FACILITIES

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

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ORGANIZATION OF 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 a second letter that generally indicates the subject matter of the section. This Standard consists of three major sections as follows:

(a) Section QR: General Requirements
(b) Section QDR: Qualification of Dynamic Restraints
(c) Section QP: Qualification of Pump Assemblies
(d) Section QV: Qualification of Valve Assemblies

2 SECTIONS

Sections are divided into articles, subarticles, 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, such as QR-1000, QP-2000, and QV-6000. Whenever possible, articles dealing with the same topics are given the same number in each section in accordance with the following general scheme:

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 allowing some 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 and 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) and 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) and 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) and QV-8321.1(a)(2).

9 REFERENCES

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 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 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 III Subsection NF paragraph 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. References listed without year of publication suggest that the latest version of the reference was utilized in the development of this Standard. 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. Section QR references applicable for both pumps and valves shall be described in Article QR-3000, while references unique to Section QP or QV only will be described in Article QP-or QV-3000, as applicable.

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

ASME QME-1–2012
SUMMARY OF CHANGES

Following approval by the ASME Committee on Qualification of Mechanical Equipment Used in Nuclear Facilities and ASME, and after public review, QME-1–2012 was approved by the American National Standards Institute on September 17, 2012.

QME-1–2012 includes the following changes identified by a margin note, **(12)**.

Page	*Location*	*Change*
1, 2	QR-1000	First paragraph revised
	QR-3000	First IEEE reference updated
	QR-4000	Definitions of *design basis event (DBE)*, *mechanical component*, *operating basis earthquake (OBE)*, and *safe shutdown earthquake (SSE)* revised
4	QR-6000	In first paragraph, sequence of sentences corrected by errata
6	QR-7340	Cross-reference deleted by errata
7–9	QR-A1000	Revised
	QR-A2000	Revised
	QR-A4000	(1) Definitions of *power spectral density (PSD)* and *system* revised (2) Definition of *stationarity* deleted by errata (3) Definition of *stationary* added by errata
10	QR-A5200	Last sentence corrected by errata to read "broadbanded"
11	QR-A5610	Cross-reference corrected by errata
	QR-A5620	In last paragraph, cross-reference corrected by errata
	QR-A5640	Last cross-reference corrected by errata
14	QR-A6600	Revised
	QR-A6810	Second paragraph revised
15	QR-A6900	Title and paragraph revised
16	QR-A7200	Title corrected by errata
20	QR-A7421	Last paragraph revised
23	QR-A8340	Appendix Attachments A, B, and C deleted
24	QR-B1000	Second paragraph revised
	QR-B3000	First IEEE reference updated

Page	*Location*	*Change*
31	QDR-4110	(1) In subparagraph (c), in fourth line, "Note that" deleted by errata (2) Subparagraph (f) corrected by errata to read "shall"
32, 33	QDR-4210	Previous Note added to subparagraph (c) text by errata
	QDR-4310	In subparagraph (b), sixth sentence corrected by errata
34	QDR-6223	Subparagraph (e) corrected by errata to read "post-aging"
36	QDR-6226	First lines of subparagraphs (a) and (b) corrected by errata
38, 39	QDR-7200	Second sentence and cross-reference corrected by errata
	QDR-7310	Subparagraph (b) corrected by errata
	QDR-7320	Subparagraphs (d), (e)(5), and (e)(7) corrected by errata
40, 41	QDR-A2000	Corrected by errata
	QDR-A5310	Subparagraph (e) revised
	QDR-A5320	Subparagraphs (a) and (b) revised
	QDR-A5400	Subparagraph (b)(9) corrected by errata
42	QDR-A6000	Revised
45, 46	QP-1000	First paragraph revised
	QP-3000	(1) API references updated (2) HI address revised (3) STLE address corrected by errata
	QP-4000	Definition of *operating point(s)* revised
	QP-6000	In first paragraph, last cross-reference corrected by errata
47	QP-6700	First cross-reference corrected by errata
	QP-6710	Subparagraph (d) revised
48	QP-6730	Subparagraph (b) revised
	QP-7310	Subparagraph (b)(1) revised
49, 50	QP-7330	Subparagraph (b)(1) revised
	QP-7340	Subparagraph (b)(1) revised
51	QP-A3000	Subparagraph (cc) revised
53	QP-B3000	Subparagraph (j) revised
54	QP-C3000	Subparagraph (f) revised
57	Table QP-E4200-1	(1) Table QP-E1 redesignated as Table QP-E4200-1 (2) Note (1) revised

Page	*Location*	*Change*
58	Table QP-E5300-1	Table QP-E2 redesignated as Table QP-E5300-1
59	Section QV	Title revised
	QV-1000	First paragraph revised
60	QV-5000	Fourth line corrected by errata to read "performance characteristics"
	QV-6000	In first paragraph, second line corrected by errata to read "performance characteristic"
61	Table QV-7300-1	(1) Table QV-7300 redesignated as Table QV-7300-1 (2) General Note (c) added by errata
62	QV-7440	First paragraph revised
63, 64	QV-7450	Subparagraph (b) revised
	QV-7461.1	(1) In subparagraph (b), end of last sentence deleted by errata (2) Subparagraphs (b)(1) through (8) redesignated by errata as (c) through (j), respectively
	QV-7461.2	(1) In subparagraph (b), end of last sentence deleted by errata (2) Subparagraphs (b)(1) through (4) redesignated by errata as (c) through (f), respectively
66	QV-7470	Revised
67	QV-7540	First paragraph revised
69, 70	QV-7564	Revised
	QV-7640	Revised
	QV-7662	Revised
	QV-8100	Subparagraphs (a) and (d) revised
72	QV-I8000	Nonmandatory Appendix QV-A deleted
73–75	QVG-1000	Subparagraph (b) revised
	QVG-2000	Revised
	QVG-3000	(1) ASME Code Case OMN-1 deleted (2) ASME OM added (3) IEEE reference updated (4) NRC Regulatory Guide 1.100 and NRC Letter revised
	QVG-5000	Revised
	QVG-6200	Subparagraph (a) revised
	QVG-6300	Revised
	QVG-6400	Revised
76	QVG-6500	First paragraph revised

Page	*Location*	*Change*
77–79	QVG-7000	Revised
	QVG-7100	Subparagraphs (a) and (b)(8) revised
	QVG-7200	(1) In subparagraph (b)(1), text redesignated as a Note (2) Subparagraph (b)(4) revised
	QVG-8110	Subparagraph (e) revised
80	QVG-8200	In subparagraph (d), Note revised
	QVG-8300	Subparagraph (b) revised

SPECIAL NOTE:

The Cases to ASME QME-1 follow the last page of this edition as a separate section.

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QUALIFICATION OF ACTIVE MECHANICAL EQUIPMENT USED IN NUCLEAR FACILITIES

Section QR
General Requirements

(12) 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.

(12) QR-3000 REFERENCES

This Section lists reference documents from which guidance, concepts, principles, practices, criteria, and parameters have been carried forward into this Standard.

ANS 51.1-1988, Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants

ANS 52.1-1988, Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants

Publisher: American Nuclear Society (ANS), 555 North Kensington Avenue, LaGrange Park, IL 60526 (www.ans.org)

IEEE Std 334-2006, Standard for Type Test of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations

IEEE Std 344-1987, Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

Publisher: Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Lane, Piscataway, NJ 08854 (www.ieee.org)

QR-4000 DEFINITIONS (12)

active mechanical equipment: mechanical equipment containing moving parts, which, in order to accomplish its required function as defined in the Qualification Specification, must undergo or prevent mechanical movement. This includes any internal components or appurtenances whose failure degrades the required function of the equipment.

aging: the cumulative effects of operational, environmental, and system conditions on equipment during a period of time up to, but not including, design basis events or the process of simulating these effects.

Application Report: documentation for a specific application showing that the required pressure ratings, qualification loading levels, and operating condition capabilities are equaled or exceeded by the corresponding pressure ratings, qualification loadings, and operating condition capabilities shown in the Functional Qualification Report.

candidate equipment: active mechanical equipment to be qualified in accordance with the rules of this Standard.

Class 1E: the safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment.

component supports: structural elements that transmit loads between the components and building structure but does not include intervening elements in the component support load path, such as electric motors and valve operators.

demonstration: the provision of evidence to support the conclusion derived from assumed premises.