ASME AG-1–2012
(Revision of ASME AG-1–2009)

Code on Nuclear Air and Gas Treatment

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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The next edition of this Code is scheduled for publication in 2014.

ASME issues written replies to inquiries concerning interpretation of technical aspects of this Code. Periodically certain actions of the ASME Committee on Nuclear Air and Gas Treatment 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.

Errata to codes and standards may be posted on the ASME Web site under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at http://cstools.asme.org/. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

The American Society of Mechanical Engineers
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FOREWORD

In 1971, the ANSI N45.8 Committee was organized to develop standards for high reliability air cleaning equipment for nuclear facilities and corresponding tests to confirm performance of the equipment. Two standards, ASME N509 and ASME N510, were published in 1975 and 1976.

In 1976, under the accredited organization rules, the Committee was reorganized as the ASME Committee on Nuclear Air and Gas Treatment. The scope of responsibility increased to include the development of codes and standards for design, fabrication, inspection, and testing of air cleaning and conditioning components and appurtenances used in safety-related systems in nuclear facilities. ASME AG-1 is the new Code resulting from the increased scope.

This Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities. Construction, as used in this Foreword, is an all-inclusive term relating to material, design, fabrication, inspection, testing, and certification. The Code does not address all aspects of these activities and those not specifically addressed may be considered. The Code is neither a handbook nor a replacement for education, experience, and the use of engineering judgment. The phrase "engineering judgment" refers to technical judgments made by knowledgeable designers experienced in the application of the Code. Engineering judgments must be consistent with Code philosophy and such judgments shall never be used to overrule mandatory requirements or specific prohibitions of the Code. The user is cautioned to carefully review these Code requirements for suitability to specific applications other than nuclear power and nuclear fuel cycle facilities.

The Code requirements established by the Committee shall not be interpreted as approving, recommending, or endorsing any proprietary design.

The Committee on Nuclear Air and Gas Treatment meets regularly to consider revisions of the Code requirements, new Code requirements as dictated by technological development, Code Cases, and requests for interpretations. Only the Committee on Nuclear Air and Gas Treatment has the authority to provide official interpretations of this Code. Requests for revisions, new Code requirements, Code Cases, or interpretations shall be addressed to the Secretary in writing and shall give full particulars in order to receive consideration and action. (See Mandatory Appendix covering preparation of technical inquiries.)

The first edition of this Code was approved by the American National Standards Institute (ANSI) on April 30, 1985, and issued on February 28, 1986. This eighth edition was approved by ANSI on November 16, 2012.

ASME COMMITTEE ON NUCLEAR AIR AND GAS TREATMENT

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

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ORGANIZATION OF ASME AG-1

1. GENERAL

The ASME Code on Nuclear Air and Gas Treatment consists of Divisions I through IV. All Divisions are broken down into Sections designated by two capital letters. Each Division is made up as follows:

Division I: General Requirements
- Section AA: Common Articles

Division II: Ventilation Air Cleaning and Ventilation Air Conditioning
- Section BA: Fans and Blowers
- Section DA: Dampers and Louvers
- Section SA: Ductwork
- Section HA: Housings
- Section RA: Refrigeration Equipment
- Section CA: Conditioning Equipment
- Section FA: Moisture Separators
- Section FB: Medium Efficiency Filters
- Section FC: HEPA Filters
- Section FD: Type II Adsorber Cells
- Section FE: Type III Adsorbers
- Section FF: Adsorbent Media
- Section FG: Mounting Frames for Air-Cleaning Equipment
- Section FH: Other Adsorbers
- Section FI: Metal Media Filters
- Section FJ: Low Efficiency Filters
- Section FK: Special HEPA Filters
- Section FL: Deep Bed Sand Filters
- Section FM: High Strength HEPA Filters
- Section IA: Instrumentation and Controls

Division III: Process Gas Treatment
- Section GA: Pressure Vessels, Piping, Heat Exchangers, and Valves
- Section GB: Noble Gas Hold-Up Equipment
- Section GC: Compressors
- Section GD: Other Radionuclide Equipment
- Section GE: Hydrogen Recombiners
- Section GF: Gas Sampling
- Section GG: Scrubbers
- Section GH: Cyclones
- Section GI: Membranes
- Section GJ: Filters
- Section GK: Mist Eliminators
- Section GL: Elastomeric Precipitators
- Section GM: Adsorbent Media

Division IV: Testing Procedures
- Section TA: Field Testing of Air Treatment Systems
- Section TB: Field Testing of Gas-Processing Systems

2. SECTIONS

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

3. ARTICLES

Articles are designated by the application letters indicated above for the sections, followed by Arabic numbers in units of 1000, such as BA-1000 or RA-2000. Where possible, articles dealing with the same topics are given the same number in each section in accordance with the following:

Article Number	Title
1000	Introduction
2000	Referenced Documents
3000	Materials
4000	Structural Design
5000	Inspection and Testing
6000	Fabrication, Joining, Welding, Brazing, Protective Coating, and Installation
7000	Packaging, Shipping, Receiving, Storage, and Handling
8000	Quality Assurance
9000	Nameplates and Stamping

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

4. SUBARTICLES

Subarticles are numbered in units of 100, such as BA-1100 or RA-1200.

5. SUBSUBARTICLES

Subsubarticles are numbered in units of 10, such as BA-2130, and generally have no text. When a number such as BA-1110 is followed by text, it is considered a paragraph.

6. PARAGRAPHS

Paragraphs are numbered in units of 1, such as BA-2131 or RA-2132.

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 BA-1111.1 or RA-1111.2. When they are minor subdivisions of a paragraph, subparagraphs may be designated by lowercase letters in parentheses, such as BA-1111(a) or RA-1111(b).

8. SUBSUBPARAGRAPHS

Subsubparagraphs are designated by adding lower case letters in parentheses to major subparagraph numbers, such as BA-1111.1(a) or RA-1111(b). When further subdivisions of minor subparagraphs are necessary, subsubparagraphs are designated by adding Arabic numerals in parentheses to the subparagraph designation, such as BA-1111(a)(1) or RA-1111(a)(2).

9. APPENDICES

Appendices pertaining to each section appear at the end of each section and are designated with the section prefix. Nonmandatory appendices are designated by letters of the alphabet, and mandatory appendices are designated by Roman numerals. Metric appendices carry the same designators as customary appendices, with the prefix "M."

ASME AG-1–2012
SUMMARY OF CHANGES

Following approval by the ASME Committee on Nuclear Air and Gas Treatment (CONAGT), and after public review, ASME AG-1–2012 was approved by the American National Standards Institute on November 16, 2012.

ASME AG-1–2012 consisits of AG-1–2009, ASME AG-1a–2009, and ASME AG-1b–2011; editorial changes, revisions, and corrections; as well as the following changes identified by a margin note, (**12**).

Page	*Location*	*Change*
2–6	AA-1100	Revised
	AA-1110	Revised
	AA-1120	Second paragraph added
	AA-1130	(1) Definitions of *Engineered Safety Feature (ESF),* nuclear safety function, and *operating basis earthquake (OBE),* revised (2) Definitions of *nonsafety-related equipment, Nuclear Air Treatment Systems (NATS), nuclear power plant operating modes, nuclear power plant process systems, nuclear safety related, safety-related equipment*, and *seismic/nonsafety-related equipment* deleted (3) Note deleted from definition of *single failure*
7	Article AA-2000	Listing of ASHRAE documents updated
10–14	Table AA-3100	Revised in its entirety
15	AA-4211	(1) Definition of *fluid momentum loads (FML)* revised (2) With definition of *normal loads (N)*, equation revised
17	AA-4244	Added
22	AA-4351.7	Last sentence revised
	AA-4351.9	Second sentence revised
28	AA-4442(k)	Revised
33	AA-6310(k)(1)(g)	Added
38	AA-6510	Third and fourth paragraphs revised
	AA-6511	Second sentence deleted
	AA-6512	Last sentence deleted
	AA-6513	Second sentence deleted
45	AA-8120	Revised
48	AA-10121	Revised
78	BA-1100	Revised
	BA-1110	Revised

Page	*Location*	*Change*
83	BA-4132	Last sentence revised
84	BA-4222.1	Third sentence revised
98	DA-1100	Revised
	DA-1110	Revised
	DA-1200	Title revised
105	DA-4212.2(c)	Revised
126	SA-1100	Revised
	SA-1110	Revised
131	SA-4211	Subparagraph (c) deleted, and subsequent subparas. (d) through (i) redesignated as (c) through (h), respectively
132	SA-4244	Second paragraph revised
134	SA-4452(e)	Revised
136	SA-4600(f)	Revised
140	SA-6140	First paragraph revised
159	SA-B-1234	First paragraph revised
162	SA-B-1320	First sentence revised
169	HA-1100	Revised
	HA-1110	Revised
	HA-1120	Second paragraph revised
175	HA-4211	Definition of *fluid momentum loads (FML)* deleted
177	HA-4245	Last paragraph revised
179	HA-4510	First paragraph revised
185	HA-6140	First paragraph revised
205	RA-1100	Revised
	RA-1200	Revised
	RA-1300(b)	Revised
	RA-1300(c)	Revised
206	Article RA-2000	References updated
209	RA-4100	Revised
	RA-4200	(1) First paragraph revised (2) Subparagraph (a) revised (3) Subparagraph (b) revised (4) Subparagraph (b)(10) deleted, and subsequent subparas. renumbered accordingly
210	RA-4300	First paragraph revised
211	RA-4432	Revised
	RA-4600	Revised
	RA-4610	Revised
	RA-4620	Revised

Page	*Location*	*Change*
212	RA-4630	(1) First paragraph revised (2) Subparagraph (c) revised
220	RA-8100	Revised in its entirety
245	Table RA-A-1000	Item RA-4200(a) revised
248	Fig. RA-B-1000	Revised
249	CA-1110	Revised
	CA-1120	Revised
	CA-1130	Revised
	CA-1220	Definition of *building structure* deleted
251	Article CA-2000	References updated
252	CA-3210	Warning statement deleted
	CA-3220	Warning statement deleted
	CA-3230	Revised
255	CA-4127	Revised
256	CA-4132(c)(3)	Revised
	CA-4134.2	Last sentence revised
260	CA-4332(b)(3)	Revised
261	CA-4423(c)	Table reference corrected
289	FA-1100	Revised
	FA-1110	Revised
302	FB-1100	Revised
	FB-1110	Revised
312	FC-1100	Revised
	FC-1110	Revised
313	Article FC-2000	References updated
314, 315	FC-3160	Subparagraphs (d) and (e) revised
316–320	FC-4100	Subparagraphs (b) and (c) revised
	FC-4130	Revised in ites entirety
	Fig. FC-4100-1	Revised
	Fig. FC-4100-3	Revised
	Fig. FC-4100-5	Revised
	FC-4150	Paragraph added
323	Table FC-5100-1	Under “Requirement” column, entry revised for FC-5120
	Table FC-5120-1	Title revised
325	FC-6212	Metric equivalents corrected
330	Article FC-I-2000	Introductory paragraph revised
331	FC-I-3110	Revised
	FC-I-3120	Second sentence revised

Page	*Location*	*Change*
332	FC-I-3234	Last sentence revised
	FC-I-3241	Title revised
	FC-I-3242	Title and paragraph revised
	FC-I-3271	Title revised
	FC-I-3272	Title and paragraph revised
	FC-I-3280	Last sentence revised
	FC-I-3300	Revised
333	Article FC-I-4000	Title revised
	FC-I-4110	Second sentence added
	FC-I-4210	Title revised
	FC-I-4221	Revised
334	FC-I-4231	Title and paragraph revised
	FC-I-4232	Title revised
	FC-I-4240	Revised
	FC-I-4261	Title and paragraph revised
	FC-I-4262	Title revised
	FC-I-4300	(1) Redesignated as FC-I-4280 and title revised (2) New FC-I-4300 addded
335	Table FC-I-4330-1	Added
339	FD-1100	Revised
	FD-1110	Revised
353	FE-1100	Revised
	FE-1110	Revised
360, 361	FE-4623.4	Penultimate sentence revised
387	FF-1100	Revised
	FF-1110	Revised
	FF-1120	First paragraph revised
398	FG-1100	Revised
	FG-1110	Revised
416	FH-1100	Revised
	FH-1110	Revised
433	FJ-1100	Revised
	FJ-1110	Revised
	FJ-1130	(1) *Extended medium filter* and *filter medium* revised to read *extended media filter* and *filter media*, respectively (2) Definitions of *extended filter media, filter media, flat-panel filter,* and *sealants* revised
435	FJ-3110	Title and paragraph revised

Page	*Location*	*Change*
443	FK-1100	Revised
	FK-1110	Revised
471–503	Section FL	Added
505	IA-1100	Revised
	IA-1110	Revised
	IA-1120	Second and third paragraphs revised
509	IA-4120	First paragraph revised
510	IA-4200	Revised
	IA-4311	Revised
	IA-4321	Revised
	IA-4325	Revised
511	IA-4420	First and second paragraphs revised
	IA-4430	First and second paragraphs revised
	IA-4511	Revised
512	IA-4539	Revised
513	IA-4811	Subparagraphs (b) and (c) revised
514	IA-4833	Revised
	IA-4910	Revised
	IA-4920	Revised
529, 530	Section GG	Added (in course of preparation)
	Section GH	Added (in course of preparation)
	Section GI	Added (in course of preparation)
	Section GJ	Added (in course of preparation)
	Section GK	Added (in course of preparation)
	Section GL	Added (in course of preparation)
	Section GM	Added (in course of preparation)
532	TA-1100	Revised
	TA-1110	Revised
	TA-1120	Revised

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Division I
General Requirements

SECTION AA
COMMON ARTICLES

AA-1000 INTRODUCTION

(12) AA-1100 SCOPE

This Code provides requirements for the performance, design, fabrication, installation, inspection, acceptance testing, and quality assurance of equipment used in air and gas treatment systems in nuclear facilities.

(12) AA-1110 PURPOSE

The purpose of this Code is to ensure that equipment used in nuclear facilities for air and gas treatment systems is acceptable in all aspects of design and operation.

(12) AA-1120 APPLICABILITY

This Code applies only to individual components in a system. This Code does not cover any functional system design requirements or sizing of complete systems, or any operating characteristics of these systems. The responsibility for meeting each requirement of this Code shall be assigned to the Owner or assigned designee.

The requirements of AG-1 for air and gas treatment components may be used for engineered safety features systems and normal systems in nuclear power generation facilities, and for air cleaning systems in other nuclear facilities. The design and procurement specifications shall delineate the design, qualification and quality assurance requirements appropriate for the application.

(12) AA-1130 DEFINITIONS AND TERMS

Each Code section shall delineate the definitions and terms unique to that section. Definitions that have common application are listed in this section.

acceptance test: a test made upon completion of fabrication, installation, repair, or modification of a unit, component, or part to verify to the user or Owner that the item meets specified requirements.

active component: any component that must perform a mechanical motion or change of state during the course of accomplishing a nuclear safety-related function.

air density: 0.075 lb/ft^3 (1.201 kg/m^3) for standard air. This corresponds to air at a pressure of 29.92 in. Hg (760 mm Hg) at a temperature of 69.8°F (21°C) with a specific volume of 13.33 ft^3/lb (0.832 m^3/kg).

airflow (ACFM, SCFM, ACMS, SCMS): expressed in terms of CFM (cubic feet of air per minute). ACFM is a cubic foot of air with a density at actual existing conditions. SCFM (standard CFM) is a cubic foot of air with a standard density. ACMS and SCMS correspondingly apply to cubic meters per second under actual and standard conditions.

allowable deflection (d_{all}): the deflection resulting from each of the component loading conditions defined in AA-4212.

allowable stress value (S): the maximum stress limit to be used in the design.

assembly: two or more devices sharing a common mounting or supporting structure.

broadband response spectrum: a response spectrum that describes the motion indicating that multiple frequency excitation predominates.

Certificate of Compliance: a written statement attesting that the materials are in accordance with specified requirements.

Certificate of Conformance: a document signed or otherwise authenticated by an authorized individual certifying the degree to which items or services meet specified requirements.

Certified Material Test Report (CMTR): a document provided by the Material Manufacturer or Material Supplier and signed by an authorized individual that contains sufficient data and information to verify the