

ASME AG-1–2017
(Revision of ASME AG-1–2015)

Code on Nuclear Air and Gas Treatment

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

ASME AG-1-2017
(Revision of ASME AG-1-2015)

Code on Nuclear Air and Gas Treatment

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: February 9, 2018

The next edition of this Code is scheduled for publication in 2020.

ASME issues written replies to inquiries concerning interpretations 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.

ASME is the registered trademark of The American Society of Mechanical Engineers.

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Standards Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment that provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity.

ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable letters patent, nor assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations of this document issued in accordance with the established ASME procedures and policies, which precludes the issuance of interpretations by individuals.

No part of this document may be reproduced in any form,
in an electronic retrieval system or otherwise,
without the prior written permission of the publisher.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

Copyright © 2018 by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
All rights reserved
Printed in U.S.A.

CONTENTS

Foreword	xxxv
Committee Roster	xxxvi
Correspondence With the Committee on Nuclear Air and Gas Treatment	xxxix
Organization of ASME AG-1	xli
Summary of Changes	xlili
Figures and Tables Redesignated in ASME AG-1–2017	xlviii
Division I	
Section AA	
Article AA-1000	
AA-1100	
AA-1200	
AA-1300	
AA-1400	
Article AA-2000	
Article AA-3000	
AA-3100	
AA-3200	
AA-3300	
AA-3400	
Article AA-4000	
AA-4100	
AA-4200	
AA-4300	
AA-4400	
Article AA-5000	
AA-5100	
AA-5200	
AA-5300	
AA-5400	
AA-5500	
AA-5600	
AA-5700	
AA-5800	
Article AA-6000	
AA-6100	
AA-6200	
AA-6300	
General Requirements	1
Common Articles	2
Introduction	2
Scope	2
Purpose	2
Applicability	2
Definitions and Terms	2
Referenced Documents	5
Materials	7
General	7
Material Substitution	7
Material Testing	7
Certification of Materials	7
Structural Design	7
Scope	7
Design Criteria	11
Design of Equipment Systems and Their Supporting Elements	13
Documentation Requirements	22
Inspection and Testing	23
General	23
Visual Inspection	23
Welded Connections	24
Bolted Connections	24
Fabrication Tolerances	24
Pressure and Leak Testing	24
Performance and Functional Testing	24
Seismic Testing	24
Fabrication, Joining, Welding, Brazing, Protective Coating, and Installation	24
General	24
Fabrication Processes	25
Welding Requirements	26

AA-6400	Brazing	29
AA-6500	Cleaning and Coating	30
AA-6600	Installation Requirements	33
Article AA-7000	Packaging, Shipping, Receiving, Storage, and Handling	34
AA-7100	General	34
AA-7200	General Requirements	34
AA-7300	Packaging	35
AA-7400	Shipping	35
Article AA-8000	Quality Assurance	35
AA-8100	General	35
AA-8200	Identification and Control of Items	36
AA-8300	Quality Assurance Records	37
Article AA-9000	Nameplates and Stamping	37
AA-9100	Scope and Applicability	37
AA-9200	Requirements	37
Article AA-10000	Repair and Replacement of Components	37
AA-10100	General	37
AA-10200	Welding	38
AA-10300	Repairs	38
AA-10400	Replacements	38
AA-10500	Records	39
Nonmandatory Appendix AA-A	Design and Qualification by Analysis	40
Article AA-A-1000	Introduction	40
Article AA-A-2000	Finite Element Method	40
Article AA-A-3000	Equipment Construction	40
Article AA-A-4000	Modeling Techniques	41
AA-A-4100	Air Handling Unit (AHU) Model	41
AA-A-4200	Fan Model	42
AA-A-4300	Instruments and Controls (I & C) Cabinets	42
AA-A-4400	Duct Supports	42
AA-A-4500	Equipment Supports	42
Article AA-A-5000	Analysis	42
AA-A-5100	Static Loads	42
AA-A-5200	Dynamic Analysis	43
Article AA-A-6000	Evaluation of Results	44
AA-A-6100	Stresses	44
AA-A-6200	Deflections	46
AA-A-6300	Support Loads	46
AA-A-6400	Connection Loading	46
AA-A-6500	Device Loading	47
Article AA-A-7000	Sample Problems	47
AA-A-7100	Scope	47
AA-A-7200	Sample AHU Analysis	47
AA-A-7300	Duct Support (Hanger) Sample Problem	47
Nonmandatory Appendix AA-B	Seismic Qualification by Testing	54

Article AA-B-1000	Test Plan	54
Article AA-B-2000	Outline for Typical Seismic Test Plan	54
AA-B-2100	Purpose	54
AA-B-2200	Scope	54
AA-B-2300	Test Specimens	54
AA-B-2400	Special Equipment or Fixtures (if Required)	54
AA-B-2500	Test Setup	54
AA-B-2600	Test Requirements	54
AA-B-2700	Acceptance/Failure Criteria	54
AA-B-2800	Test Procedure	54
AA-B-2900	Final Report	55
Article AA-B-3000	Commentary on Outline for Typical Seismic Test Plan	55
AA-B-3100	Purpose	55
AA-B-3200	Scope	55
AA-B-3300	Test Specimens	55
AA-B-3400	Special Equipment or Fixtures	55
AA-B-3500	Test Setup	55
AA-B-3600	Test Requirements	56
AA-B-3700	Acceptance and Failure Criteria	57
AA-B-3800	Test Procedure	57
AA-B-3900	Final Report	57
Nonmandatory Appendix AA-C	Qualification by a Combination of Analysis and Testing	58
Article AA-C-1000	Introduction	58
Article AA-C-2000	Qualification by Analysis Only	58
Article AA-C-3000	Qualification by Testing Only	58
AA-C-3100	Testing Program Considerations	58
Article AA-C-4000	Supporting Test	58
AA-C-4100	Common Applications	58
AA-C-4200	Dynamic and Static Supporting Tests	58
Division II	Ventilation Air Cleaning and Ventilation Air Conditioning	60
Section BA	Fans and Blowers	61
Article BA-1000	Introduction	61
BA-1100	Scope	61
BA-1200	Purpose	61
BA-1300	Applicability	61
BA-1400	Definitions and Terms	61
Article BA-2000	Referenced Documents	62
Article BA-3000	Materials	63
BA-3100	General	63
BA-3200	Special Limitations on Materials	63
BA-3300	Designation of Materials	63
BA-3400	Certification of Materials	63
BA-3500	Purchased Materials	63
BA-3600	Driver Materials	63
Article BA-4000	Design	63

BA-4100	Design Conditions	63
BA-4200	Selection	65
BA-4300	Construction	66
BA-4400	Reports and Calculations	68
Article BA-5000	Inspection and Testing	68
BA-5100	Fan Inspection and Testing	68
BA-5200	Driver Inspection and Testing	70
Article BA-6000	Fabrication and Installation of Centrifugal and Axial Fans	70
BA-6100	Fabrication	70
BA-6200	Installation	70
Article BA-7000	Packaging, Shipping, Receiving, Storage, and Handling	70
BA-7100	General	70
BA-7200	Packaging	70
BA-7300	Shipping	70
BA-7400	Receiving	70
BA-7500	Storage	70
BA-7600	Drivers Shipped Separately	70
Article BA-8000	Quality Assurance	71
BA-8100	General	71
BA-8200	Required Documentation for Fans	71
BA-8300	Drawings and Documentation	71
Article BA-9000	Nameplates and Operating and Maintenance Manuals	71
BA-9100	General	71
BA-9200	Fans	71
BA-9300	Acceptable Methods for Marking Accessories	71
BA-9400	Operating and Maintenance Manuals	71
Nonmandatory Appendix BA-A	Fan System Considerations	72
Article BA-A-1000	Fan System Considerations	72
BA-A-1100	System Characteristics	72
BA-A-1200	System Effects on Fan Performance	72
BA-A-1300	Fan and System Matching	72
BA-A-1400	Fan-System Capacity Control	72
BA-A-1500	Multiple Fan Systems	72
Nonmandatory Appendix BA-B	Division of Responsibility	73
Section DA	Dampers and Louvers	76
Article DA-1000	Introduction	76
DA-1100	Scope	76
DA-1200	Purpose	76
DA-1300	Applicability	76
DA-1400	Definitions and Terms	76
Article DA-2000	Referenced Documents	78
Article DA-3000	Materials	78
DA-3100	Allowable Materials	78
DA-3200	Special Limitations on Materials	78
DA-3300	Certification of Materials	78

Article DA-4000	Design	79
DA-4100	General Design	79
DA-4200	Technical Requirements	79
DA-4300	Actuators	82
DA-4400	Accessories	83
Article DA-5000	Inspection and Testing	83
DA-5100	Testing	83
Article DA-6000	Fabrication, Finishing, and Installation	84
DA-6100	Welding and Brazing	84
Article DA-7000	Packaging, Shipping, and Storage	85
Article DA-8000	Quality Assurance	85
DA-8100	Damper and Louver Performance	85
DA-8300	Quality Assurance Records	85
Article DA-9000	Nameplates, Stampings, and Manuals	85
DA-9100	Nameplates and Stampings	85
DA-9200	Manuals	85
Mandatory Appendix DA-I	Seat and Frame Leakage	86
Mandatory Appendix DA-II	Damper and Louver Configurations	87
Nonmandatory Appendix DA-A	Division of Responsibility	93
Section SA	Ductwork	96
Article SA-1000	Introduction	96
SA-1100	Scope	96
SA-1200	Purpose	96
SA-1300	Applicability	96
SA-1400	Definitions and Terms	96
Article SA-2000	Referenced Documents	97
Article SA-3000	Materials	97
SA-3100	General	97
SA-3200	Material Substitution	97
SA-3300	Material Testing	97
SA-3400	Material Specifications	97
Article SA-4000	Design	99
SA-4100	General	99
SA-4200	Design Criteria	99
SA-4300	Ductwork Joints and Seams	100
SA-4400	Components	101
SA-4500	Pressure Boundary Leakage	102
SA-4600	Design Specification	103
Article SA-5000	Inspection and Testing	103
SA-5100	General	103
SA-5200	Visual Inspection	103
SA-5300	Pressure Boundary Leakage Testing	104
SA-5400	Structural Capability Tests	105
Article SA-6000	Fabrication and Installation	105
SA-6100	General	105

SA-6200	Fabrication Processes	105
SA-6300	Mechanical Fastening	106
SA-6400	Fabrication Tolerances	106
SA-6500	Installation Tolerances	106
SA-6600	Cleaning, Finishing, and Coating	106
Article SA-7000	Packaging, Shipping, Receiving, Storage, and Handling	106
SA-7100	General	106
SA-7200	Packaging	106
SA-7300	Shipping	107
SA-7400	Receiving	107
SA-7500	Storage	109
Article SA-8000	Quality Assurance	109
SA-8100	General	109
SA-8200	Material Identification	109
SA-8300	Drawings and Documentation	109
Article SA-9000	Nameplates and Stamping	109
SA-9100	General	109
SA-9200	Stamping/Marking	109
Nonmandatory Appendix SA-A	Division of Responsibility	110
Nonmandatory Appendix SA-B	Procedures to Determine Allowable Leakage for Ductwork	111
Article SA-B-1000	. . . . .	111
SA-B-1100	Purpose	111
SA-B-1200	Allowable Leakage by Health Physics Criteria	111
SA-B-1300	Additional Leakage Criteria	121
SA-B-1400	Air Cleaning System Configurations and Leakage Classes	122
Nonmandatory Appendix SA-C	Additional Guidelines for Duct Design and Construction	126
Article SA-C-1000	. . . . .	126
SA-C-1100	Functional Design	126
SA-C-1200	General	126
SA-C-1300	Duct Construction Standards	127
Section HA	Housings	128
Article HA-1000	Introduction	128
HA-1100	Scope	128
HA-1200	Purpose	128
HA-1300	Applicability	128
HA-1400	Definitions and Terms	128
Article HA-2000	Referenced Documents	128
Article HA-3000	Materials	129
HA-3100	Allowable Materials	129
HA-3200	Special Limitations on Materials	129
HA-3300	Certification of Material	129
Article HA-4000	Design	131
HA-4100	General Design	131
HA-4200	Design Criteria	131
HA-4300	Housing Joints and Seams	133

HA-4400	Accessories	133
HA-4500	Pressure Boundary Leakage	135
HA-4600	Design Specification	135
Article HA-5000	Inspection and Testing	136
HA-5100	General	136
HA-5200	Inspection	136
HA-5300	Pressure Boundary Leakage Testing	136
HA-5400	Mounting Frame to Housing Leakage Test	137
HA-5500	Structural Capability Test	137
HA-5600	Airflow Distribution Tests	137
HA-5700	Air-Aerosol Mixing Uniformity Tests	137
HA-5800	Sampling Manifold Testing	137
HA-5900	Air Conditioning and Air Handling Unit Testing	138
Article HA-6000	Fabrication	138
HA-6100	General	138
HA-6200	Fabrication Process	138
HA-6300	Mechanical Fastening	138
HA-6400	Fabrication Tolerances	139
HA-6500	Cleaning	139
Article HA-7000	Packaging, Shipping, Receiving, Storage, and Handling	139
HA-7100	General	139
HA-7200	Packaging	139
HA-7300	Shipping	139
HA-7400	Receiving	139
HA-7500	Storage	139
Article HA-8000	Quality Assurance	140
HA-8100	General	140
HA-8200	Material Identification	140
HA-8300	Drawings and Documentation	140
Article HA-9000	Nameplates and Stamping	140
HA-9100	General	140
HA-9200	Stamping/Marking	140
Nonmandatory Appendix HA-A	Division of Responsibility	141
Nonmandatory Appendix HA-B	Additional Guidelines for Housing Design and Construction	142
Article HA-B-1000	. . . . .	142
HA-B-1100	Functional Design	142
HA-B-1200	General	142
Nonmandatory Appendix HA-C	Manifold Design Guidelines	144
Article HA-C-1000	. . . . .	144
HA-C-1100	General	144
HA-C-1200	Manifold Requirements for In-Place Tests	144
HA-C-1300	Considerations for Use of Permanently Installed Manifolds	144
HA-C-1400	Injection Manifolds	145
HA-C-1500	Sample Manifolds	147
Nonmandatory Appendix HA-D	Performance Test for Qualification of Sampling Manifolds	151

Article HA-D-1000	.....	151
HA-D-1100	Purpose	151
HA-D-1200	Limits	151
HA-D-1300	Test Requirements	151
HA-D-1400	Test Method	151
HA-D-1500	Acceptance Criteria	152
HA-D-1600	Documentation	152
HA-D-1700	Acceptance of Results	152
Section RA	Refrigeration Equipment	153
Article RA-1000	Introduction	153
RA-1100	Scope	153
RA-1200	Purpose	153
RA-1300	Applicability	153
RA-1400	Definitions and Terms	153
Article RA-2000	Referenced Documents	153
Article RA-3000	Materials	154
RA-3100	General Material Requirements	154
Article RA-4000	Design Requirements	155
RA-4100	Purpose	155
RA-4200	Design Specification	155
RA-4300	Equipment Performance Requirements	155
RA-4400	Mechanical Design Requirements	156
RA-4500	Structural Design Requirements	157
RA-4600	Electrical Design Requirements	157
RA-4700	Maintenance Criteria	158
Article RA-5000	Inspection, Rating, and Testing	158
RA-5100	Rating	158
RA-5200	Testing	158
RA-5300	Nondestructive Examination	160
Article RA-6000	Fabrication and Installation	160
RA-6100	Welding and Brazing	160
RA-6200	Cleaning, Finishing, and Coating	161
RA-6300	Installation	161
Article RA-7000	Packaging, Shipping, Storage, and Handling	161
RA-7100	General Requirements	161
RA-7200	Packaging	161
RA-7300	Shipping	161
RA-7400	Storage	161
RA-7500	Handling and Rigging	161
RA-7600	Assembly, Erection, and Start-Up	162
Article RA-8000	Quality Assurance	162
RA-8100	General	162
Article RA-9000	Nameplates, Stamping, and Records	162
RA-9100	General Requirements	162
RA-9200	Nameplates and Stamping	162

RA-9300	Data Reports	162
Mandatory Appendix RA-I	Performance Testing of Chilled Water Refrigeration Unit (U.S. Customary)	177
Article RA-I-1000	General	177
RA-I-1100	Paragraph A4.1.1	177
RA-I-1200	Effect of Fouling Factors	177
RA-I-1300	Paragraph A7.3.1	177
RA-I-1400	Paragraph A7.3.3	177
RA-I-1500	Paragraph A8.1.1	177
RA-I-1600	Power Input	177
RA-I-1700	Refrigeration Machines Equipped With Subcoolers	177
Mandatory Appendix RA-MI	Performance Testing of Chilled Water Refrigeration Unit (SI)	180
Article RA-MI-1000	General	180
RA-MI-1100	Paragraph A4.1.1	180
RA-MI-1200	Effect of Fouling Factor	180
RA-MI-1300	Paragraph A7.3.1	180
RA-MI-1400	Paragraph A7.3.3	180
RA-MI-1500	Paragraph A8.1.1	180
RA-MI-1600	Power Input	180
RA-MI-1700	Refrigeration Machines Equipped With Subcoolers	180
Mandatory Appendix RA-II	Mandatory List of Instrumentation Functions and Control Functions .	183
Nonmandatory Appendix RA-A	Division of Responsibility	184
Nonmandatory Appendix RA-B	Typical External Interface Diagrams	187
Section CA	Conditioning Equipment	188
Article CA-1000	Introduction	188
CA-1100	Scope	188
CA-1200	Purpose	188
CA-1300	Applicability	188
CA-1400	Definitions and Terms	188
Article CA-2000	Referenced Documents	189
Article CA-3000	Materials	189
CA-3100	Material Specifications	189
CA-3200	Water, Steam, and Volatile Refrigerant Coil Materials	190
CA-3400	Electric Heating Coil Materials	190
CA-3500	Certification of Materials	190
Article CA-4000	Design	191
CA-4100	Design Conditions for Water and Steam Coils	191
CA-4200	Design Conditions for Volatile Refrigerant Coils	193
CA-4400	Design Conditions for Electric Heating Coils	194
Article CA-5000	Inspection and Testing	196
CA-5100	General Requirements	196
CA-5200	Testing of Water, Steam, and Volatile Refrigerant Coils	196
CA-5400	Testing of Electric Heating Coils	197
CA-5500	Test Reports	198
Article CA-6000	Fabrication and Installation	198

CA-6100	General Requirements	198
CA-6200	Cleaning, Finishing, and Coating	199
Article CA-7000	Packaging, Shipping, Storage, and Handling	199
CA-7100	General Requirements	199
CA-7200	Packaging	199
CA-7300	Shipping	200
CA-7400	Storage	200
CA-7500	Handling	200
Article CA-8000	Quality Assurance	200
CA-8100	General Requirements	200
Article CA-9000	Nameplates and Records	201
CA-9100	General Requirements	201
CA-9200	Coils	201
CA-9300	Information on Nameplates	201
CA-9400	Nameplate Visibility	202
CA-9500	Data Reports	202
Article CA-10000	Repairs and Replacements	202
CA-10100	General	202
Nonmandatory Appendix CA-A	Division of Responsibility	205
Nonmandatory Appendix CA-B	Design Recommendations	206
Article CA-B-1000	Recommended Design Criteria for Water, Steam, and Volatile Refrigerant Coils	206
CA-B-1100	Scope	206
CA-B-1200	General Recommendations	206
Section FA	Moisture Separators	207
Article FA-1000	Introduction	207
FA-1100	Scope	207
FA-1200	Purpose	207
FA-1300	Applicability	207
FA-1400	Definitions and Terms	207
Article FA-2000	Referenced Documents	207
Article FA-3000	Materials	207
FA-3100	Allowable Materials	207
FA-3200	Limitations	207
FA-3300	Material Certification	208
Article FA-4000	Design	208
FA-4100	General Design	208
FA-4200	Technical Requirements	208
FA-4300	Structural Requirements	208
Article FA-5000	Inspection and Testing	208
FA-5100	Qualification Tests	208
FA-5200	Production Inspection and Testing	210
Article FA-6000	Fabrication	210
FA-6100	Repairs	210
FA-6200	Cleaning	210

FA-6300	Tolerances	210
Article FA-7000	Packaging, Shipping, and Storage	210
Article FA-8000	Quality Assurance	210
FA-8100	Responsibility	210
FA-8200	Documentation	210
FA-8300	Certificate of Conformance	211
Article FA-9000	Nameplates	211
FA-9100	Moisture Separator Marking	211
FA-9200	Package Marking	211
Nonmandatory Appendix FA-A	Division of Responsibility	212
Section FB	Medium Efficiency Filters	213
Article FB-1000	Introduction	213
FB-1100	Scope	213
FB-1200	Purpose	213
FB-1300	Applicability	213
FB-1400	Definitions and Terms	213
Article FB-2000	Referenced Documents	213
Article FB-3000	Materials	213
FB-3100	Allowable Materials	213
FB-3200	Special Limitations of Materials	214
Article FB-4000	Design	214
FB-4100	General Design	214
FB-4200	Design Criteria	214
FB-4300	Structural Requirements	214
Article FB-5000	Inspection and Testing	214
FB-5100	Inspection Plan	214
FB-5200	Qualification Testing	214
Article FB-6000	Fabrication	215
FB-6100	General	215
FB-6200	Manufacture and Assembly	215
Article FB-7000	Packaging, Shipping, Receiving, Storage, and Handling	215
FB-7100	General	215
Article FB-8000	Quality Assurance	215
FB-8100	General	215
FB-8200	Documentation	215
Article FB-9000	Labels and Marking	215
FB-9100	Filter Markings	215
FB-9200	Package Marking	216
Nonmandatory Appendix FB-A	Division of Responsibility	217
Section FC	HEPA Filters	218
Article FC-1000	Introduction	218
FC-1100	Scope	218
FC-1200	Purpose	218
FC-1300	Applicability	218
FC-1400	Definitions and Terms	218

Article FC-2000	Referenced Documents	218
Article FC-3000	Materials	219
FC-3100	Allowable Materials	219
FC-3200	Special Limitations of Materials	220
Article FC-4000	Design	220
FC-4100	General Design	220
FC-4200	Performance Requirements	224
FC-4300	Seismic Qualification	225
Article FC-5000	Inspection and Testing	225
FC-5100	Qualification Testing	225
FC-5200	Inspection	227
FC-5300	Production Testing	227
Article FC-6000	Fabrication	227
FC-6100	General Requirements	227
FC-6200	Manufacture and Assembly	227
FC-6300	Workmanship	227
Article FC-7000	Packaging, Shipping, and Storage	227
Article FC-8000	Quality Assurance	227
FC-8100	Responsibility	227
FC-8200	Certificate of Conformance	227
Article FC-9000	Nameplates	228
FC-9100	Filter Marking	228
FC-9200	Package Marking	228
Mandatory Appendix FC-I	Filter Media: Fire-Resistant, High Efficiency	229
Article FC-I-1000	Scope	229
Article FC-I-2000	Referenced Documents	229
Article FC-I-3000	Requirements	229
FC-I-3100	Form and Size	229
FC-I-3200	Physical and Chemical	230
FC-I-3300	Workmanship	231
Article FC-I-4000	Inspection and Testing	231
FC-I-4100	Qualification Testing	231
FC-I-4200	Test Procedures	231
FC-I-4300	Production Testing	232
Article FC-I-5000	Quality Assurance Provisions	232
FC-I-5100	Responsibility for Inspection	232
Article FC-I-6000	Packaging and Shipping	232
FC-I-6100	Packaging	232
FC-I-6200	Shipping	232
Nonmandatory Appendix FC-A	Division of Responsibility	234
Section FD	Type II Adsorber Cells	235
Article FD-1000	Introduction	235
FD-1100	Scope	235
FD-1200	Purpose	235
FD-1300	Applicability	235

FD-1400	Definitions and Terms	235
Article FD-2000	Referenced Documents	235
Article FD-3000	Materials	236
FD-3100	Allowable Materials	236
FD-3200	Limits	236
FD-3300	Certification of Materials	236
Article FD-4000	Design	236
FD-4100	General Design	236
FD-4200	Technical Requirements	236
FD-4300	Structural Requirements	238
Article FD-5000	Inspection and Testing	238
FD-5100	Dimensional Inspection	238
FD-5200	Welding Inspection	239
FD-5300	Qualification Tests	239
Article FD-6000	Fabrication	239
FD-6100	Dimensions and Tolerances	240
FD-6200	Welding and Brazing	240
FD-6300	Filling	240
FD-6400	Cleaning	240
Article FD-7000	Packaging and Shipping	240
FD-7100	Packaging	240
FD-7200	Loading for Shipment	240
FD-7300	Storage	240
FD-7400	Containers	240
Article FD-8000	Quality Assurance	241
FD-8100	Documentation	241
Article FD-9000	Nameplates and Certification	241
FD-9100	Permanent Nameplate	241
FD-9200	Filling Label	241
Mandatory Appendix FD-I	Calculation of Residence Time of Adsorber Cells	242
Article FD-I-1000	Residence Time	242
Mandatory Appendix FD-II	Sample Canisters	243
Article FD-II-1000	. . . . .	243
FD-II-1100	Scope	243
FD-II-1200	Applicability	243
FD-II-1300	Definitions and Terms	243
Article FD-II-2000	General Design	243
FD-II-2100	Technical Requirements	243
Article FD-II-3000	Filling Method Qualification	243
Article FD-II-4000	Nameplates	245
Article FD-II-5000	Filling Label	245
Nonmandatory Appendix FD-A	Division of Responsibility	246
Section FE	Type III Adsorbers	247
Article FE-1000	Introduction	247
FE-1100	Scope	247

FE-1200	Purpose	247
FE-1300	Applicability	247
FE-1400	Definitions and Terms	247
Article FE-2000	Referenced Documents	248
Article FE-3000	Materials	248
FE-3100	Allowable Materials	248
Article FE-4000	Design	248
FE-4100	General	248
FE-4200	Technical Requirements	248
FE-4300	Adsorbent Bed Details	250
FE-4400	Structural Requirements	250
FE-4500	Adsorbent Handling Subsystems	251
FE-4600	Auxiliary Systems	251
Article FE-5000	Inspection and Testing	252
FE-5100	General	252
FE-5200	Visual Inspection	253
FE-5300	Dimensional Inspection	253
FE-5400	Welding Inspection	253
FE-5500	Fabrication Tolerances	253
FE-5600	Design Qualification	253
FE-5700	Acceptance Tests	253
Article FE-6000	Fabrication and Installation	253
FE-6100	General	253
FE-6200	Welding	253
FE-6300	Cleaning	253
FE-6400	Construction and Installation	254
FE-6500	Repairs	254
Article FE-7000	Packaging and Shipping	254
FE-7100	Type III Adsorbers	254
FE-7200	Adsorbent Materials	254
Article FE-8000	Quality Assurance	254
FE-8100	General	254
FE-8200	Inspection Reports and Documentation	254
Article FE-9000	Nameplates	254
FE-9100	Permanent Nameplates	254
FE-9200	Filling Label	254
Mandatory Appendix FE-I	Residence Time Calculation	255
Article FE-I-1000	Calculation of Residence Time of Adsorbers	255
Mandatory Appendix FE-II	Screen Waviness Inspection Test	256
Article FE-II-1000	Screen Waviness	256
Article FE-II-2000	Procedure	256
Article FE-II-3000	Acceptance Criteria	256
Mandatory Appendix FE-III	Adsorber Filling Qualification Test Procedure	257
Article FE-III-1000	Scope	257
Article FE-III-2000	Purpose	257

Article FE-III-3000	.....	257
Article FE-III-4000	Procedure	257
FE-III-4100	Adsorbent Characteristics	257
FE-III-4200	Packing Density	257
FE-III-4300	Adsorbent Losses	257
Article FE-III-5000	Qualification Reports	258
Article FE-III-6000	Acceptance Criteria	258
Mandatory Appendix FE-IV	Type III Adsorber Qualification Test Procedure	259
Article FE-IV-1000	Scope	259
Article FE-IV-2000	Purpose	259
Article FE-IV-3000	Theory	259
Article FE-IV-4000	Example	260
FE-IV-4100	Apparatus	260
FE-IV-4200	Test Procedure	260
FE-IV-4300	RH Measurement	261
FE-IV-4400	RH Breakthrough	261
FE-IV-4500	Adsorbent Sampling	261
FE-IV-4600	Moisture Content	261
Article FE-IV-5000	Acceptance Criteria	261
Mandatory Appendix FE-V	Sample Canisters	262
Article FE-V-1000	.....	262
FE-V-1100	Scope	262
FE-V-1200	Applicability	262
FE-V-1300	Definitions and Terms	262
Article FE-V-2000	General Design	262
FE-V-2100	Technical Requirements	262
Article FE-V-3000	Filling Method Qualification	262
Article FE-V-4000	Nameplates	263
Article FE-V-5000	Filling Label	263
Nonmandatory Appendix FE-A	Visual Inspection Recommendations for Type III Adsorbers	264
Article FE-A-1000	General	264
FE-A-1100	Adsorber Sections	264
FE-A-1200	Adsorber Assembly	264
FE-A-1300	Adsorber Service Systems	264
FE-A-1400	Inspection Openings	264
FE-A-1500	Labeling	264
Nonmandatory Appendix FE-B	Division of Responsibility	265
Section FF	Adsorbent Media	266
Article FF-1000	Introduction	266
FF-1100	Scope	266
FF-1200	Purpose	266
FF-1300	Applicability	266
FF-1400	Definitions and Terms	266
Article FF-2000	Referenced Documents	266
Article FF-3000	Materials	267

Article FF-4000	Design	267
FF-4100	General Design	267
FF-4200	Adsorbent Degradation	267
Article FF-5000	Inspection and Testing	267
FF-5100	Physical Testing	268
FF-5200	Radioactive Testing	268
FF-5300	Acceptable ASTM Standards	268
Article FF-6000	Fabrication	268
Article FF-7000	Packaging and Shipping	268
FF-7100	Protection of Adsorbent Media	268
FF-7200	Storage	269
FF-7300	Containers	269
Article FF-8000	Quality Assurance	269
FF-8100	Documentation	269
Article FF-9000	Nameplate and Certification	269
Nonmandatory Appendix FF-A	Division of Responsibility	270
Section FG	Mounting Frames for Air-Cleaning Equipment	271
Article FG-1000	Introduction	271
FG-1100	Scope	271
FG-1200	Limitations	271
FG-1300	Purpose	271
FG-1400	Responsibility	271
Article FG-2000	Referenced Documents	271
Article FG-3000	Materials	271
FG-3100	Allowable Materials	271
FG-3200	Material Limitations	271
Article FG-4000	Design	271
FG-4100	General Design	271
FG-4200	Structural Requirements	275
FG-4300	Structural Design Analysis	275
Article FG-5000	Inspection and Testing	276
FG-5100	Dimensional Inspection	276
FG-5200	Alignment and Surface Finish for HEPA Filter and Type II Adsorber Cell Mounting Frames	276
FG-5300	Alignment and Surface Finish for Medium Efficiency Filter and Moisture Separator Mounting Frames	277
FG-5400	Weld Inspection	277
FG-5500	Coating Inspection	277
Article FG-6000	Fabrication	277
FG-6100	General	277
FG-6200	Welding	277
FG-6300	Clamping Devices	277
FG-6400	Cleaning	277
FG-6500	Coating	277
Article FG-7000	Packaging and Shipping	277
Article FG-8000	Quality Assurance	278

Article FG-9000	Nameplates	278
Nonmandatory Appendix FG-A	Division of Responsibility	279
Section FH	Other Adsorbers	282
Article FH-1000	Introduction	282
FH-1100	Scope	282
FH-1200	Purpose	282
FH-1300	Applicability	282
FH-1400	Definitions and Terms	282
Article FH-2000	Referenced Documents	282
Article FH-3000	Materials	282
FH-3100	Allowable Materials	282
FH-3200	Limits	282
FH-3300	Certification of Materials	282
Article FH-4000	Design	283
FH-4100	General Design	283
FH-4200	Technical Requirements	284
FH-4300	Structural Requirements	286
Article FH-5000	Inspection and Testing	287
FH-5100	Dimensional Inspection	287
FH-5200	Welding Inspection	287
FH-5300	Qualification Tests	287
FH-5400	Acceptance Tests	287
Article FH-6000	Fabrication	288
FH-6100	Dimensions and Tolerances	288
FH-6200	Welding	288
FH-6300	Filling	288
FH-6400	Cleaning	288
Article FH-7000	Packaging and Shipping	288
FH-7100	Packaging	288
FH-7200	Loading for Shipment	288
FH-7300	Storage	289
FH-7400	Containers	289
Article FH-8000	Quality Assurance	289
FH-8100	Documentation	289
Article FH-9000	Nameplates and Certification	289
FH-9100	Permanent Nameplate	289
FH-9200	Filling Label	289
Nonmandatory Appendix FH-A	Division of Responsibility	290
Section FI	Metal Media Filters	291
Section FJ	Low Efficiency Filters	292
Article FJ-1000	Introduction	292
FJ-1100	Scope	292
FJ-1200	Purpose	292
FJ-1300	Applicability	292
FJ-1400	Definitions and Terms	292

Article FJ-2000	Referenced Documents	292
Article FJ-3000	Materials	292
FJ-3100	Allowable Materials	292
FJ-3200	Special Limitations of Materials	293
Article FJ-4000	Design	293
FJ-4100	General Design	293
FJ-4200	Design Criteria	293
FJ-4300	Structural Requirements	293
Article FJ-5000	Inspection and Testing	293
FJ-5100	Inspection Plan	293
FJ-5200	Qualification Testing	293
Article FJ-6000	Fabrication	294
FJ-6100	General	294
FJ-6200	Manufacture and Assembly	294
Article FJ-7000	Packaging, Shipping, Receiving, Storage, and Handling	294
FJ-7100	General	294
Article FJ-8000	Quality Assurance	294
FJ-8100	General	294
FJ-8200	Documentation	294
Article FJ-9000	Labels and Markings	294
FJ-9100	Filter Markings	294
FJ-9200	Package Markings	295
Nonmandatory Appendix FJ-A	Division of Responsibility	296
Section FK	Special HEPA Filters	297
Article FK-1000	Introduction	297
FK-1100	Scope	297
FK-1200	Purpose	297
FK-1300	Applicability	297
FK-1400	Definitions and Terms	297
Article FK-2000	Referenced Documents	298
Article FK-3000	Materials	299
FK-3100	Allowable Materials	299
FK-3200	General Material Requirements	300
Article FK-4000	Design	300
FK-4100	General Design	300
FK-4200	Performance Requirements	306
FK-4300	Structural Requirements	306
Article FK-5000	Qualification, Inspection, and Production Testing	306
FK-5100	Qualification Testing for Type 1 Radial Flow Filters	306
FK-5200	Qualification Testing for Type 2 Axial Flow Circular Filters	309
FK-5400	Qualification Testing for Type 4 Axial Flow Rectangular Filters	311
FK-5500	Inspection	313
FK-5600	Production Testing	313
Article FK-6000	Fabrication	313
FK-6100	General	313

FK-6200	Manufacture and Assembly	313
FK-6300	Workmanship	314
Article FK-7000	Packaging, Shipping, and Storage	314
Article FK-8000	Quality Assurance	314
FK-8100	Responsibility	314
FK-8200	Certificate of Conformance	314
Article FK-9000	Nameplates	314
FK-9100	Filter Marking	314
FK-9200	Package Marking	314
Nonmandatory Appendix FK-A	Determination of HEPA Filter Service Life	315
Nonmandatory Appendix FK-B	Division of Responsibility	316
Section FL	Deep Bed Sand Filters	317
Article FL-1000	Introduction	317
FL-1100	Scope	317
FL-1200	Purpose	317
FL-1300	Applicability	317
FL-1400	Definitions and Terms	317
Article FL-2000	Referenced Documents	317
Article FL-3000	Materials	318
FL-3100	Allowable Materials	318
FL-3200	Special Limitations of Materials	319
FL-3300	Certification of Materials	319
Article FL-4000	Design	319
FL-4100	General Deep Bed Sand Filter Design	319
FL-4200	Design Criteria	319
FL-4300	Structural Requirements	321
Article FL-5000	Inspection and Testing	321
FL-5100	Acceptance Tests	321
FL-5200	Inspection Plan	322
FL-5300	Qualification and Verification Testing	323
Article FL-6000	Fabrication/Field Construction	324
FL-6100	General	324
FL-6200	Fabrication and Assembly	324
FL-6300	Installation	324
FL-6400	Tolerances	324
Article FL-7000	Packaging, Shipping, Receiving, Storage, and Handling	325
FL-7100	General Requirements	325
FL-7200	Filter Media	325
Article FL-8000	Quality Assurance	325
FL-8100	General	325
FL-8200	Identification and Completed Material	325
Article FL-9000	Labels and Markings	325
FL-9100	Deep Bed Sand Filter Markings	325
FL-9200	Package Marking	325
FL-9300	Filter Media	325

Mandatory Appendix FL-I	Air-Aerosol Mixing Test Procedural Guidelines	326
Article FL-I-1000	General	326
FL-I-1100	System Test	326
FL-I-1200	Summary of Method	326
FL-I-1300	Injection Port Selection Criteria	326
FL-I-1400	Downstream Sample Port Selection Criteria	326
Article FL-I-2000	Prerequisites	326
Article FL-I-3000	Test Equipment	326
Article FL-I-4000	Procedural Guidelines	326
FL-I-4100	General	326
FL-I-4200	Downstream Sample Port Qualification	327
Mandatory Appendix FL-II	Deep Bed Sand Filter In-Place Leak Test Procedural Guidelines	328
Article FL-II-1000	General	328
FL-II-1100	Summary of Method	328
Article FL-II-2000	Prerequisites	328
Article FL-II-3000	Test Equipment and Procedures	328
FL-II-3100	Test Equipment	328
FL-II-3200	Procedural Guidelines	328
Nonmandatory Appendix FL-A	Division of Responsibility	329
Nonmandatory Appendix FL-B	Guidelines for Deep Bed Sand Filters	330
Article FL-B-1000	DBS Filter Material Selection	330
FL-B-1100	General	330
FL-B-1200	Filter Media	330
FL-B-1300	DBS Filter Structure and Distribution Channels	330
Article FL-B-2000	Design Guidelines	330
FL-B-2100	General	330
FL-B-2200	Design Attributes	331
FL-B-2300	Examples of Support Structure Arrangement	331
FL-B-2400	End of Life	331
Article FL-B-3000	Inspection and Testing Guidelines	331
FL-B-3100	Filter Media Acceptance Test Procedures	331
FL-B-3200	Seismic	334
FL-B-3300	Smoke Loading	334
Article FL-B-4000	Fabrication Guidelines	334
FL-B-4100	General	334
FL-B-4200	Filter Media Placement	334
Section FM	High-Strength HEPA Filters	336
Section IA	Instrumentation and Controls	337
Article IA-1000	Introduction	337
IA-1100	Scope	337
IA-1200	Purpose	337
IA-1300	Applicability	337
IA-1400	Definitions and Terms	337
Article IA-2000	Referenced Documents	337
Article IA-3000	Materials	338

IA-3100	Materials of Construction	338
IA-3200	Nonpermissible Materials	338
IA-3300	Restricted Materials	339
IA-3400	Certification of Material	339
Article IA-4000	Design Requirements	339
IA-4100	General Design	339
IA-4200	Single-Failure Criteria	340
IA-4300	Separation Criteria	340
IA-4400	Qualification of Equipment	340
IA-4500	Panels	341
IA-4600	Mounted Instruments and Sensors	342
IA-4700	Interconnecting Wiring for Skid-Mounted Components	342
IA-4800	Instrument-Sensing Lines and Field-Installed Tubing	342
IA-4900	Instrument Setpoints	343
Article IA-5000	Inspection and Testing	343
IA-5100	General	343
IA-5200	Visual Inspection	343
IA-5300	Calibration and Testing	343
Article IA-6000	Panel Fabrication and Assembly	344
IA-6100	General Requirements	344
IA-6200	Fabrication Process	344
IA-6300	Welding	344
IA-6400	Brazing	344
IA-6500	Cleaning and Coating	344
IA-6600	Installation Requirements: Handling and Rigging	344
IA-6700	Material Identification	344
Article IA-7000	Packaging, Shipping, Receiving, Storage, and Handling	344
IA-7100	General Requirements	344
IA-7200	Packaging	344
IA-7300	Shipping	345
IA-7400	Receiving	345
IA-7500	Storage	345
Article IA-8000	Quality Assurance	345
IA-8100	General	345
IA-8200	Test Reports and Data	345
Article IA-9000	Nameplates	345
IA-9100	General	345
IA-9200	Requirements	345
IA-9300	Nameplate Specifications	345
Nonmandatory Appendix IA-A	Division of Responsibility	347
Nonmandatory Appendix IA-B	Sample Checklist for Visual Examination of Control Panels/Enclosures, Instruments, and Control Devices	348
Nonmandatory Appendix IA-C	Instrumentation for Nuclear Air and Gas Treatment Systems	349
Article IA-C-1000	. . . . .	349
IA-C-1100	Purpose	349

IA-C-1200	Functional Design	349
Division III	Process Gas Treatment	351
Section GA	Heat Exchangers	352
Article GA-1000	Introduction	352
GA-1100	Scope	352
GA-1200	Purpose	352
GA-1300	Applicability	352
GA-1400	Definitions and Terms	352
Article GA-2000	Referenced Documents	353
Article GA-3000	Materials	354
GA-3100	General Requirements	354
GA-3200	Materials for Heat Exchangers	354
GA-3300	Certification of Materials	354
Article GA-4000	Design	354
GA-4100	Design Specifications	354
GA-4200	Structural Requirements for Heat Exchangers	355
GA-4300	Design Conditions for Shell-and-Tube Heat Exchangers	356
GA-4400	Design Conditions for Gasketed Plate and Frame Heat Exchangers	357
GA-4500	Design Conditions for Braze-Plate Heat Exchangers	359
GA-4600	Design Conditions for Welded-Plate Heat Exchangers	360
Article GA-5000	Inspection and Testing	362
GA-5100	General Requirements	362
GA-5200	Testing	362
GA-5300	Nondestructive Examination	362
Article GA-6000	Fabrication and Installation	363
GA-6100	General Requirements	363
GA-6200	Welding	363
GA-6300	Brazing	363
GA-6400	Mechanical Joining	363
GA-6500	Cleaning, Finishing, and Coating	363
GA-6600	Installation	364
Article GA-7000	Packaging, Shipping, Handling, and Storage	364
GA-7100	General Requirements	364
GA-7200	Packaging	364
GA-7300	Shipping	365
GA-7400	Storage	365
GA-7500	Handling	366
Article GA-8000	Quality Assurance	366
GA-8100	General Requirements	366
GA-8200	Documentation and Retention	366
Article GA-9000	Nameplates and Records	367
GA-9100	General Requirements	367
GA-9200	Heat Exchangers	367
GA-9300	Information on Heat Exchanger Nameplates	367
GA-9400	Nameplate Visibility	367

GA-9500	Data Reports	367
Article GA-10000	Repairs and Replacements	367
GA-10100	General	367
Nonmandatory Appendix GA-A	Division of Responsibility	368
Nonmandatory Appendix GA-B	Design Recommendations for Gasketed Plate and Frame Heat Exchangers	369
Article GA-B-1000	. . . . .	369
Section GB	Noble Gas Hold-Up Equipment	370
Section GC	Gas Compressors and Exhausters	371
Article GC-1000	Introduction	371
GC-1100	Scope	371
GC-1200	Purpose	371
GC-1300	Applicability	371
GC-1400	Definitions and Terms	371
Article GC-2000	Referenced Documents	372
GC-2100	General	372
Article GC-3000	Materials	372
GC-3100	General	372
GC-3200	Special Limitations on Materials	372
GC-3300	Certification of Materials	372
GC-3400	Purchased Materials	373
GC-3500	Driver Materials	373
Article GC-4000	Design	373
GC-4100	Design Conditions	373
GC-4200	Specification Design Requirements	374
GC-4300	Construction	375
GC-4400	Reports and Calculations	376
Article GC-5000	Inspection and Testing	377
GC-5100	Compressor Inspection and Testing	377
GC-5200	Driver Inspection and Testing	378
Article GC-6000	Fabrication and Installation	378
GC-6100	General	378
GC-6200	Fabrication	378
GC-6300	Installation	378
Article GC-7000	Packaging, Shipping, Receiving, and Storage	378
GC-7100	General	378
GC-7200	Packaging	379
GC-7300	Shipping	379
GC-7400	Receiving	379
GC-7500	Storage	379
Article GC-8000	Quality Assurance	379
GC-8100	General	379
GC-8200	Required Documentation	379
GC-8300	Drawings and Documentation	379
Article GC-9000	Nameplates and Operating and Maintenance Manuals	379

GC-9100	General	379
GC-9200	Required Nameplate Data	379
GC-9300	Accessories	380
GC-9400	Installation, Operation, and Maintenance Manuals	380
Mandatory Appendix GC-I	Shaft Leakage	381
Mandatory Appendix GC-II	System Considerations	382
Article GC-II-1000	. . . . .	382
GC-II-1100	System Characteristics	382
GC-II-1200	System Effects on Performance	382
GC-II-1300	Equipment and System Matching	382
GC-II-1400	System Capacity Control	382
GC-II-1500	Multiple-Unit Systems	382
Nonmandatory Appendix GC-A	Division of Responsibility	383
Section GD	Other Radionuclide Equipment	385
Section GE	Hydrogen Recombiners and Igniters	386
Article GE-1000	Introduction	386
GE-1100	Scope	386
GE-1200	Purpose	386
GE-1300	Applicability	386
GE-1400	Definitions and Terms	386
Article GE-2000	Referenced Documents	388
Article GE-3000	Materials	388
GE-3100	General Requirements	388
GE-3200	PAR	388
GE-3300	Igniter	389
Article GE-4000	Design	389
GE-4100	General Design	389
GE-4200	PAR	389
GE-4300	Igniter	389
GE-4400	Structural Requirements	390
Article GE-5000	Inspection and Testing	390
GE-5100	General	390
GE-5200	Performance Testing	390
Article GE-6000	Fabrication and Installation	391
GE-6100	General Requirements	391
GE-6200	Fabrication Processes	391
GE-6300	Welding	391
GE-6400	Brazing	391
GE-6500	Cleaning and Coating	391
GE-6600	Installation Requirements	392
Article GE-7000	Packaging, Shipping, Receiving, Storage, and Handling	392
GE-7100	General Requirements	392
GE-7200	Packaging	392
GE-7300	Shipping	392
GE-7400	Storage	392

GE-7500	Receiving	392
GE-7600	Handling and Rigging	392
GE-7700	Assembly, Erection, and Start-Up	392
Article GE-8000	Quality Assurance	392
GE-8100	General Requirements	392
GE-8200	Identification and Control of Items	392
GE-8300	Documentation	392
Article GE-9000	Nameplates and Certification	393
GE-9100	General Requirements	393
GE-9200	Information on Nameplates	393
GE-9300	PAR Nameplate Location	393
GE-9400	Data Reports	393
Article GE-10000	Repair and Replacement of Components	393
GE-10100	General Requirements	393
Nonmandatory Appendix GE-A	Division of Responsibility	394
Nonmandatory Appendix GE-B	Illustrations of Components	395
Article GE-B-1000	Introduction	395
Nonmandatory Appendix GE-C	Periodic Testing Guidelines	397
Article GE-C-1000	Periodic Testing Guidelines	397
GE-C-1100	In-Service Test Requirements	397
GE-C-1200	Structural Inspection	397
Section GF	Gas Sampling	398
Section GG	Scrubbers	399
Section GH	Cyclones	400
Section GI	Membranes	401
Section GJ	Filters	402
Section GK	Mist Eliminators	403
Section GL	Elastomeric Precipitators	404
Section GM	Noble Gas Hold-Up Media	405
Article GM-1000	Introduction	405
GM-1100	Scope	405
GM-1200	Applicability	405
GM-1300	Definitions and Terms	405
Article GM-2000	Referenced Documents	405
Article GM-3000	Materials	406
GM-3100	Activated Carbon	406
Article GM-4000	Design	406
GM-4100	Activated Carbon	406
Article GM-5000	Inspection and Testing	406
GM-5100	Introduction	406
GM-5200	Activated Carbon for Noble Gas Delay	406
Article GM-6000	Fabrication	406
GM-6100	Fabrication Guidelines	406
Article GM-7000	Packaging, Shipping, Storage, and Handling	406
GM-7100	General Requirements	406

GM-7200	Protection of Carbon Media	407
GM-7300	Packaging	407
GM-7400	Storage	407
GM-7500	Handling	407
GM-7600	Shipping	407
GM-7700	Marking	407
Article GM-8000	Quality Control	408
GM-8100	General Requirements	408
GM-8200	Documentation	408
Article GM-9000	Nameplate and Certification	408
GM-9100	Nameplate, Certification, and Shipping Information	408
Nonmandatory Appendix GM-A	Division of Responsibility	409
Nonmandatory Appendix GM-B	Determination of the Dynamic Adsorption Coefficient — Radioactive Tracer Method	410
Article GM-B-1000	Introduction	410
GM-B-1100	Scope	410
GM-B-1200	Applicable Documents	410
Article GM-B-2000	Summary of Methods	410
Article GM-B-3000	Apparatus and Equipment	410
Article GM-B-4000	Sample Preparation	410
Article GM-B-5000	Preparation of Apparatus	412
Article GM-B-6000	Calibration	412
Article GM-B-7000	Procedure	412
GM-B-7100	System Dead Time Determination	412
GM-B-7200	Determination of Average Delay Time	412
Article GM-B-8000	Report	412
Division IV	Testing Procedures	414
Section TA	Field Testing of Air Treatment Systems	415
Article TA-1000	Introduction	415
TA-1100	Scope	415
TA-1200	Purpose	415
TA-1300	Applicability	415
TA-1400	Definitions and Terms	415
Article TA-2000	Referenced Documents	416
Article TA-3000	General Inspection and Test Requirements	416
TA-3100	General	416
TA-3200	Test Instruments	416
TA-3300	Establishment of Reference Values	417
TA-3400	Inspections and Test Requirements	417
TA-3500	Generic Tests	418
TA-3600	Acceptance Criteria	419
Article TA-4000	Field Acceptance Tests	419
TA-4100	Fan Acceptance Tests	419
TA-4200	Damper Acceptance Tests	420
TA-4300	Duct, Housing, and Mounting Frame Acceptance Tests	422

TA-4400	Refrigeration Equipment Acceptance Tests	422
TA-4500	Conditioning Equipment Acceptance Tests	423
TA-4600	Moisture Separator, Prefilter, and HEPA Filter Bank Acceptance Tests . . .	425
TA-4700	Types II, III, and IV Adsorber Bank Acceptance Tests	426
TA-4800	Adsorbent Acceptance Tests	427
TA-4900	Integrated System Tests	427
Article TA-5000	Corrective Action Requirements	428
Article TA-6000	Quality Assurance	428
TA-6100	General	428
TA-6200	Personnel	428
TA-6300	Documentation	428
Mandatory Appendix TA-I	Visual Inspection Checklist	429
Article TA-I-1000	General	429
TA-I-1100	Fan Inspection Items	429
TA-I-1200	Damper Inspection Items	429
TA-I-1300	Duct, Housing, and Mounting Frame Inspection Items	429
TA-I-1400	Refrigeration Equipment Inspection Items	429
TA-I-1500	Conditioning Equipment Inspection Items	430
TA-I-1600	Moisture Separator Bank, Prefilter Bank, and HEPA Filter Bank Inspection Items	430
TA-I-1700	Types II, III, and IV Adsorber Bank Inspection Items	430
Mandatory Appendix TA-II	Structural Capability Test Procedural Guidelines	431
Article TA-II-1000	General	431
TA-II-1100	Summary of Method	431
Article TA-II-2000	Prerequisites	431
Article TA-II-3000	Test Equipment	431
Article TA-II-4000	Procedural Guidelines	431
Article TA-II-5000	Acceptance Criteria	431
Mandatory Appendix TA-III	Duct and Housing Leak Test Procedural Guidelines	432
Article TA-III-1000	General	432
TA-III-1100	Summary of Method	432
Article TA-III-2000	Prerequisites	432
Article TA-III-3000	Test Equipment	432
Article TA-III-4000	Procedural Guidelines	432
TA-III-4100	Constant Pressure Test	432
TA-III-4200	Pressure Decay Test	433
TA-III-4300	Acceptance Criteria	433
TA-III-4400	Bubble Leak Location Method	433
TA-III-4500	Audible Leak Location Method	433
Mandatory Appendix TA-IV	Airflow Distribution Test Procedural Guidelines	434
Article TA-IV-1000	General	434
TA-IV-1100	Summary of Method	434
Article TA-IV-2000	Prerequisites	434
Article TA-IV-3000	Test Equipment	434
Article TA-IV-4000	Procedural Guidelines	434

Mandatory Appendix TA-V	Air-Aerosol Mixing Test Procedural Guidelines	435
Article TA-V-1000	General	435
TA-V-1100	System Test	435
TA-V-1200	Summary of Method	435
TA-V-1300	Injection Port Selection Criteria	435
TA-V-1400	Downstream Sample Port Selection Criteria	435
Article TA-V-2000	Prerequisites	435
Article TA-V-3000	Test Equipment	435
Article TA-V-4000	Procedural Guidelines	435
TA-V-4100	General	435
TA-V-4200	Downstream Sample Port Qualification	436
Mandatory Appendix TA-VI	HEPA Filter Bank In-Place Leak Test Procedural Guidelines	437
Article TA-VI-1000	General	437
TA-VI-1100	Summary of Method	437
Article TA-VI-2000	Prerequisites	437
Article TA-VI-3000	Test Equipment	437
Article TA-VI-4000	Procedural Guidelines	437
Mandatory Appendix TA-VII	Adsorber Bank In-Place Leak Test Procedural Guidelines	438
Article TA-VII-1000	General	438
TA-VII-1100	Summary of Method	438
Article TA-VII-2000	Prerequisites	438
Article TA-VII-3000	Test Equipment	438
Article TA-VII-4000	Procedural Guidelines	438
Mandatory Appendix TA-VIII	Refrigerant Piping and Coil System Leak Test Procedural Guidelines	439
Article TA-VIII-1000	General	439
TA-VIII-1100	Summary of Method	439
Article TA-VIII-2000	Prerequisites	439
Article TA-VIII-3000	Test Equipment	439
Article TA-VIII-4000	Procedural Guidelines	439
TA-VIII-4100	Leak Test Procedural Guidelines	439
TA-VIII-4200	Evacuation and Dehydration Procedure	439
Nonmandatory Appendix TA-A	Mounting Frame Pressure Leak Test Procedural Guidelines	441
Article TA-A-1000	General	441
TA-A-1100	Summary of Method	441
Article TA-A-2000	Prerequisites	441
Article TA-A-3000	Test Equipment	441
Article TA-A-4000	Procedural Guidelines	441
Nonmandatory Appendix TA-B	Corrective Action Guidance	442
Article TA-B-1000	. . . . .	442
Nonmandatory Appendix TA-C	Challenge Gas and Aerosol Substitute Selection Criteria	443
Article TA-C-1000	. . . . .	443
TA-C-1100	Alternative Challenge Gases	443
TA-C-1200	Alternative Challenge Aerosols	443
Section TB	Field Testing of Gas-Processing Systems	444

Mandatory Appendix I	Preparation of Technical Inquiries to the Committee on Nuclear Air and Gas Treatment	445
Nonmandatory Appendix A	Format Guide for Technical Inquiries	446
 Figures		
AA-4355.3-1	Sine Beat Frequency and Amplitude	19
AA-4355.4-1	Sine Amplitude Decay Rate	19
AA-4356.4-1	Response Spectrum of Composite Excitation	20
AA-4356.4-2	Oscillations per Beat	21
AA-6324.2-1	Acceptable and Unacceptable Weld Profiles	28
AA-8130-1	Hierarchy of Responsibility	36
AA-A-4200-1	Isometric View of a Typical Fan Model	43
AA-A-4300-1	Isometric View of a Typical I & C Cabinet Model	44
AA-A-4400-1	Isometric View of a Typical Duct Support Model	45
AA-A-4500-1	Isometric View of a Typical Refrigeration Equipment Support	46
AA-A-7200-1	Computer Plots of Finite Element Model of Sample AHU (Perspective View of Tri-Plate Mesh)	48
AA-A-7310-1	Typical Duct Support As-Built (Dimensions and Member Sizes Not Shown)	50
AA-A-7311-1	Ductwork Support Baseplate Model	51
AA-A-7324-1	Effective Duct Cross Section	52
AA-A-7325-1	Typical Duct System Model	53
DA-II-1000-1	Parallel Blade Damper	87
DA-II-1000-2	. . . . .	88
DA-II-1000-3	. . . . .	89
DA-II-1000-4	Slide Gate Guillotine Damper	90
DA-II-1000-5	. . . . .	91
DA-II-1000-6	. . . . .	92
SA-1300-1	Ductwork and Ductwork Support — Interface Boundary	98
SA-B-1221-1	Allowable Unit Leakage From Duct or Housing to Occupied Space	112
SA-B-1222-1	System Parameters	115
SA-B-1232.1-1	Control Room System Flow Diagram	117
SA-B-1232.2-1	Control Room System Flow Diagram With Leakage Paths	118
SA-B-1410-1	Single-Pass Air Cleaning System Configuration	123
SA-B-1410-2	Recirculating Air Cleaning System Configurations	124
SA-B-1410-3	Recirculating Air Cleaning System Configurations	125
HA-1300-1	Housing, Air Cleaning Unit: Walk-In Type	130
HA-1300-2	Housing, Air Cleaning Unit: Side-Access Type	130
HA-1300-3	Housing, Air Conditioning Unit: Walk-In Type	131
HA-C-1230-1	Common Configurations Requiring Test Manifolds (Plan A)	145
HA-C-1230-2	Common Configurations Requiring Test Manifolds (Plan B)	146
HA-C-1230-3	Common Configurations Requiring Test Manifolds (Plan C)	147
HA-C-1230-4	Common Configurations Requiring Test Manifolds (Plan D)	148
HA-C-1230-5	Common Configurations Requiring Test Manifolds (Plan E)	149
RA-B-1000-1	Interface Points — Typical Two-Vessel Design	187
FA-4100-1	Typical Moisture Separation Configuration	209
FC-4110-1	Type A, C, or D Metal-Cased, Gasket-Sealed Filter	220

FC-4110-2	Type A Wood Case Separator Filter	221
FC-4110-3	Type B Minipleat Filter	221
FC-4110-4	Type C Separatorless Filter	222
FC-4110-5	Type D Thread Separator Filter	222
FC-4142-1	Gel Seal Filter Corner — Isometric	224
FD-4100-1	Type II Adsorber Cell	237
FD-II-2000-1	Examples of Sample Canister Configurations	244
FD-II-2110-1	Detail of a Typical 2-in. Sample Canister	245
FE-4110-1	Horizontal Section of Type III Adsorber Bed	249
FE-IV-3000-1	. . . . .	260
FE-IV-4100-1	. . . . .	261
FG-4110-1	Typical Filter Mounting Frame	272
FG-4120-1	Typical Type II Adsorber Mounting Frame	273
FG-4140-1	Typical Moisture Separator Mounting Frame	274
FH-4100-1	Type IV “V” Adsorbers Model (Fluid Seal Version)	283
FH-4100-2	Type IV “V” Bed Adsorbers Model (Gasketed Version)	284
FH-4100-3	Type IV “V” Adsorbers Model, Exploded View	285
FH-4100-4	Type IV “U” Bed Adsorbers Model (Gasketed Version)	286
FK-4111-1	Type 1 Radial Flow HEPA Filter (Internal Gasket), Midsection View	301
FK-4111-2	Type 1 Radial Flow HEPA Filter (Internal Gelatinous Seal), Midsection View	302
FK-4111-3	Type 1 Radial Flow HEPA Filter (External Gasket), Midsection View	303
FK-4111-4	Type 1 Radial Flow HEPA Filter (External Gelatinous Seal), Midsection View	304
FK-4112-1	Type 2 Axial Flow Circular HEPA Filters	305
FL-4120-1	Typical DBS Filter Cross Section, DOE-HDBK-1169-2003	320
FL-B-2300-1	Sand-Filter Cross Sections	332
GA-4311-1	Typical Shell-and-Tube Heat Exchanger	356
GA-4411-1	Gasketed Plate and Frame Heat Exchanger	358
GA-4510-1	Brazed-Plate Heat Exchanger	360
GA-4611-1	Typical Welded-Plate Heat Exchanger	361
GE-B-1000-1	Typical PAR	395
GE-B-1000-2	Typical Igniter	396
GM-B-3000-1	Schematic of Noble Gas Delay Test Apparatus	411
GM-B-7100-1	Typical Traces for Measurement of Delay Time, T_{delay} , for Dynamic K Determination	413

Tables

AA-3100-1	Allowable Materials	8
AA-4212-1	Load Conditions	12
AA-4230-1	Deflection Limits	13
AA-4321-1	Plate- and Shell-Type Components: Primary Stress Allowables	15
AA-4323-1	Linear-Type Systems: Primary Stress Allowables	16
AA-10530-1	Lifetime Repair and Replacement Records	39
AA-10540-1	Nonpermanent Repair and Replacement Records	39
AA-A-1000-1	Analysis Considerations	41
BA-4162-1	Maximum Allowable Displacement	65

BA-B-1000-1	Division of Responsibility	74
DA-I-1000-1	Maximum Permissible Seat Leakage Rate, scfm/ft ² (scmh/m ²), of Damper or Adjustable Louver Face Area at 1 in. wg (25.4 mm wg) Differential Pressure	86
DA-I-1000-2	Maximum Permissible Frame Leakage Rate Classes at Frame Design Pressure	86
DA-A-1000-1	Division of Responsibility	94
SA-6400-1	Rectangular Ducts: Maximum Allowable Tolerances	107
SA-6400-2	Circular Ducts: Maximum Allowable Tolerances	108
SA-6400-3	Flatness of Surface: Maximum Allowable Waviness Tolerance	108
SA-A-1000-1	Division of Responsibility	110
SA-B-1234-1	Control Room Air Cleaning System Parameters for Leakage Analysis	121
SA-B-1234-2	Control Room Air Conditioning System Parameters for Leakage Analysis	122
SA-B-1310-1	Maximum Allowable Leakage Factors for Air Cleaning Effectiveness	122
SA-C-1300-1	. . . . .	127
HA-4212-1	Load Combinations	132
HA-A-1000-1	Division of Responsibility	141
RA-I-1100-1	. . . . .	178
RA-I-1200-1	. . . . .	178
RA-I-1300-1	. . . . .	178
RA-I-1500-1	. . . . .	179
RA-MI-1100-1	. . . . .	181
RA-MI-1200-1	. . . . .	181
RA-MI-1300-1	. . . . .	181
RA-MI-1500-1	. . . . .	182
RA-II-1000-1	Mandatory List of Instrumentation Functions and Control Functions	183
RA-A-1000-1	Division of Responsibility	185
CA-4122-1	Maximum Water Velocities in Water Coils	192
CA-8121-1	Lifetime Quality Assurance Records	201
CA-8121-2	Nonpermanent Quality Assurance Records	201
CA-A-1000-1	Division of Responsibility	205
FA-4100-1	Moisture Separator Performance Specifications	208
FA-A-1000-1	Division of Responsibility	212
FB-A-1000-1	Division of Responsibility	217
FC-4110-1	Nominal Sizes and Ratings	223
FC-5100-1	Test Groups and Sequence	225
FC-5120-1	Acceptable Test	226
FC-5140-1	Test Conditions and Requirements	226
FC-I-4330-1	Filter Media Qualification and Production Tests	233
FC-A-1000-1	Division of Responsibility	234
FD-5332-1	Detector Sensitivity for Leak Test	239
FD-6100-1	Cell Dimensions and Tolerances	240
FD-A-1000-1	Division of Responsibility	246
FE-B-1000-1	Division of Responsibility	265
FF-A-1000-1	Division of Responsibility	270
FG-A-1000-1	Division of Responsibility	280
FH-6100-1	Dimensional Requirements	288

FH-A-1000-1	Division of Responsibility	290
FJ-A-1000-1	Division of Responsibility	296
FK-4111-1	Type 1 Radial Flow HEPA Filter — Nominal Rating	300
FK-4112-1	Type 2 Axial Flow Circular HEPA Filter — Nominal Rating	306
FK-4200-1	Performance Requirements	307
FK-5100-1	Test Groups and Sequence — Type 1 Radial Flow HEPA Filters	308
FK-5140-1	Test Conditions and Requirements	308
FK-5200-1	Test Groups and Sequence — Type 2 Axial Flow Circular HEPA Filters	309
FK-5400-1	Test Groups and Sequence — Type 4 Axial Flow Rectangular HEPA Filters	312
FK-B-1000-1	Division of Responsibility	316
FL-A-1000-1	Division of Responsibility	329
IA-3100-1	Allowable Materials	339
IA-A-1000-1	Division of Responsibility	347
IA-B-1000-1	Sample Checklist for Visual Examination of Control Panels/Enclosures, Instruments, and Control Devices	348
IA-C-1220-1	Instrumentation for Nuclear Air and Gas Treatment Systems	350
GA-A-1000-1	Division of Responsibility	368
GC-I-1000-1	Maximum Permissible Shaft Leakage Rate, scfm, at Pressure Differential Between Operating and Ambient	381
GC-A-1000-1	Division of Responsibility	384
GE-4410-1	Load Conditions — Housing and Support	390
GE-A-1000-1	Division of Responsibility	394
GM-A-1000-1	Division of Responsibility	409
TA-3200-1	Instrument Accuracy Requirements	417
TA-4110-1	Fan Acceptance Tests	420
TA-4210-1	Damper Acceptance Tests	421
TA-4310-1	Duct, Housing, and Frame Acceptance Tests	422
TA-4410-1	Refrigeration Equipment Acceptance Tests	423
TA-4510-1	Conditioning Equipment Acceptance Tests	424
TA-4610-1	Moisture Separator, Prefilter, and HEPA Filter Acceptance Tests	426
TA-4710-1	Types II, III, and IV Adsorber Bank Acceptance Tests	426
 Forms		
RA-1	Manufacturer’s Data Report for Section RA Non-ASME Nuclear Vessels (U.S. Customary)	163
RA-M1	Manufacturer’s Data Report for Section RA Non-ASME Nuclear Vessels (SI)	165
RA-2	Centrifugal Compressor Test Record	167
RA-2a	Centrifugal Compressor Oil Pump Pressure Test	168
RA-2b	Centrifugal Compressor Pressure Test Record	169
RA-3	Reciprocating Scroll/Screw Compressor Test Record	170
RA-3a	Reciprocating Scroll/Screw Compressor Pressure Test Record	171
RA-4	Electrical Test Record — Controls and Control Panels	172
RA-5	Performance Test Record (U.S. Customary)	173
RA-M5	Performance Test Record (SI)	175

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 was 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 the [Correspondence With the Committee](#) page.)

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 edition was approved by ANSI on May 22, 2017.

ASME COMMITTEE ON NUCLEAR AIR AND GAS TREATMENT

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

STANDARDS COMMITTEE

R. R. Bellamy, *Chair*, Camfil USA, Inc.
E. M. Banks, *Vice Chair*, NUCON International, Inc.
H. A. Mearns, *Vice Chair*, Department of Homeland Security, Science and Technology, Chemical Security Analysis Center
O. Martinez, *Secretary*, The American Society of Mechanical Engineers
K. Verderber, *Secretary*, The American Society of Mechanical Engineers
D. J. Adamson, Savannah River National Laboratory
R. K. Aggarwal, Sargent & Lundy, LLC
T. B. Axley, Jr., Consultant
J. O. Bettle, U.S. Nuclear Regulatory Commission
M. A. Doersam, Ellis & Watts Global Industries, Inc.
M. J. Fox, ECU Corp.
B. Franklin
D. Ghosh, Southern Nuclear
C. E. Graves, NUCON International, Inc.

M. R. Hahn, U.S. Department of Energy
M. R. Hargan, Hargan Engineering
J. R. Hunt, NCS Corp.
R. T. Jubin, Oak Ridge National Laboratory
A. M. Kouvolo, Consultant
G. G. Pyle, Knolls Atomic Power Laboratory
C. I. Ricketts, New Mexico State University
J. B. Roberts, National Security Technologies, LLC
J. C. Royer, Sargent & Lundy, LLC
A. Stillo, Camfil USA, Inc.
T. J. Vogan, Consultant
C. A. Waggoner, Mississippi State University — Institute for Clean Energy Technology
N. S. Zaremba, Newport News Shipbuilding
N. J. Cocklin, *Delegate*, Cavendish Nuclear
A. Soma, *Contributing Member*, Camfil USA, Inc.
R. R. Sommer II, *Contributing Member*, NUCON International, Inc.

EXECUTIVE COMMITTEE

E. M. Banks, *Chair*, NUCON International, Inc.
H. A. Mearns, *Chair*, Department of Homeland Security, Science and Technology, Chemical Security Analysis Center
R. R. Bellamy, *Vice Chair*, Camfil USA, Inc.
O. Martinez, *Secretary*, The American Society of Mechanical Engineers
K. Verderber, *Secretary*, The American Society of Mechanical Engineers

M. A. Doersam, Ellis & Watts Global Industries, Inc.
D. Ghosh, Southern Nuclear
R. T. Jubin, Oak Ridge National Laboratory
J. C. Royer, Sargent & Lundy, LLC
A. Soma, Camfil USA, Inc.
T. J. Vogan, Consultant
N. S. Zaremba, Newport News Shipbuilding

CONAGT HONORARY MEMBERS

J. R. Edwards, Consultant
M. W. First, Harvard School of Public Health Air Cleaning Laboratory
J. L. Kovach, NUCON International, Inc.
R. Porco, RDP Consulting Services
D. J. Gladden

C. Golden, Whirlpool Corp.
L. J. Klaes, Consultant
W. H. Miller, Jr.
S. C. Ornberg, Consultant
R. R. Weidler, Consultant

SUBCOMMITTEE ON ADSORPTION

E. M. Banks, *Chair*, NUCON International, Inc.
A. Soma, *Vice Chair*, Camfil USA, Inc.
R. K. Aggarwal, Sargent & Lundy, LLC
R. R. Bellamy, Camfil USA, Inc.
R. Blose, SSM Industries, Inc.
N. J. Cockin, Cavendish Nuclear

M. A. Doersam, Ellis & Watts Global Industries, Inc.
W. P. Freeman, Jacobi
C. E. Graves, NUCON International, Inc.
R. T. Jubin, Oak Ridge National Laboratory
C. B. Summers, NUCON International, Inc.
D. Gibbs, *Contributing Member*, Camfil USA, Inc.

SUBCOMMITTEE ON COMMON EQUIPMENT

M. A. Doersam, *Chair*, Ellis & Watts Global Industries, Inc.
L. Krooswyk, *Vice Chair*, Burns & McDonnell
J. M. Apablaza-Lorca, Washington River Protection Solutions, LLC
T. B. Axley, Jr., Consultant
R. Flye, Washington River Protection Solutions, LLC
D. Gibbs, Camfil USA, Inc.
N. Handschke, American Air Filter
Z. Hostetler, SSM Industries
S. Khabir, Washington River Protection Solutions/Hanford
W. H. Lampkin, Greenheck Fan Corp.

D. S. Maletich, The New York Blower Co.
C. Massar, Ruskin Co.
J. B. Roberts, National Security Technologies, LLC
J. C. Royer, Sargent & Lundy, LLC
A. Soma, Camfil USA, Inc.
M. T. Sorna, Puget Sound Naval Shipyard
M. G. Wiltfong, Ruskin Co.
D. Schoepflin, *Contributing Member*, Washington River Protection Solutions
G. D. Singleton, *Contributing Member*, AAF International

SUBCOMMITTEE ON FILTRATION

H. A. Mearns, *Chair*, Department of Homeland Security, Science and Technology, Chemical Security Analysis Center
A. Stillo, *Vice Chair*, Camfil USA, Inc.
D. J. Adamson, Savannah River National Laboratory
W. Bergman, Aerosol Science
S. Dinakaran, Flanders Filters
D. M. Dykes, Consultant
G. Garcia, Bechtel National, Inc.
M. R. Hahn, U.S. Department of Energy
C. A. Hart, Air Techniques International Test Laboratory
S. Jaganathan, Hollingsworth and Vose
J. Levinson, Newport News Shipbuilding
L. E. Major, Lydall
M. A. Mitchell, Lawrence Livermore National Laboratory
G. W. Moore, Camfil USA, Inc.
D. P. Nguyen, U.S. Army Edgewood Chemical Biological Center
G. G. Pyle, Knolls Atomic Power Laboratory

C. I. Ricketts, New Mexico State University
K. L. Rubow, Mott Corp.
S. R. Salisbury, Los Alamos National Laboratory
J. W. Slawski, Federal Aviation Administration
J. A. Stormo, Mississippi State University — Institute for Clean Energy Technology
C. A. Waggoner, Mississippi State University — Institute for Clean Energy Technology
M. S. Win, U.S. Army Edgewood Chemical Biological Center
N. S. Zaremba, Newport News Shipbuilding
J. S. MacMurray, *Contributing Member*, Savannah River National Laboratory
D. Schoepflin, *Contributing Member*, Washington River Protection Solutions
S. K. Sen, *Contributing Member*, U.S. Department of Energy
L. D. Weber, *Contributing Member*, Stony Brook University

SUBCOMMITTEE ON GAS PROCESS TREATMENT EQUIPMENT

R. T. Jubin, *Chair*, Oak Ridge National Laboratory
M. R. Hargan, *Vice Chair*, Hargan Engineering
T. B. Axley, Jr., Consultant
M. Bauer, Westinghouse Electric Germany GmbH
S. Brink, Australian Nuclear Science and Technology Organisation
M. J. Fox, ECU Corp.
D. Ghosh, Southern Nuclear
D. Klein, AREVA NP, Inc.

J. R. Kriskovich, Kurion, Inc.
D. Ryland, Canadian Nuclear Laboratories
M. Sulva, Fluor Corp.
B. K. Austin, *Contributing Member*, URS Corp.
C. A. Curtis, *Contributing Member*, West Valley Nuclear
W. P. Drosjack, *Contributing Member*, Consultant
I. Kutuzov, *Contributing Member*, Alfa Laval, Inc. (Canada)

SUBCOMMITTEE ON GENERAL SUPPORT SERVICES

J. C. Royer, *Chair*, Sargent & Lundy, LLC
R. K. Aggarwal, *Vice Chair*, Sargent & Lundy, LLC
J. O. Bettle, U.S. Nuclear Regulatory Commission
M. A. Doersam, Ellis & Watts Global Industries, Inc.
R. Flye, Washington River Protection Solutions, LLC
B. Franklin
D. J. Grover, Defense Nuclear Facilities Safety Board
S. Khabir, Washington River Protection Solutions/Hanford

M. Kmetz, Bechtel
K. G. Nelson, Porvair Filtration Group, Inc.
G. Roca, Westinghouse Electric Spain
T. J. Schaefer, Sargent & Lundy, LLC
M. Sulva, Fluor Corp.
T. J. Vogan, Consultant
W. F. Williams, Jr., AREVA NP, Inc.
R. Blose, *Contributing Member*, SSM Industries, Inc.

SUBCOMMITTEE ON TECHNOLOGY

A. Soma, *Chair*, Camfil USA, Inc.
N. S. Zaremba, *Vice Chair*, Newport News Shipbuilding
R. K. Aggarwal, Sargent & Lundy, LLC

T. B. Axley, Jr., Consultant
E. M. Banks, NUCON International, Inc.
D. Ghosh, Southern Nuclear

C. E. Graves, NUCON International, Inc.
J. R. Kriskovich, Kurion, Inc.
J. C. Medley, National Security Technologies, LLC
D. P. Nguyen, U.S. Army Edgewood Chemical Biological Center
J. C. Royer, Sargent & Lundy, LLC

R. R. Sommer II, NUCON International, Inc.
C. B. Summers, NUCON International, Inc.
T. J. Vogan, Consultant
C. A. Waggoner, Institute for Clean Energy Technology

SUBCOMMITTEE ON TESTING AND INSPECTION

N. S. Zaremba, *Chair*, Newport News Shipbuilding
J. C. Medley, *Vice Chair*, National Security Technologies, LLC
E. M. Banks, NUCON International, Inc.
S. Barnette, U.S. Department of Energy
K. S. Eng, U.S. Army Research, Development and Engineering Command
R. Flye, Washington River Protection Solutions, LLC
M. R. Hahn, U.S. Department of Energy
J. Hunt, NCS Corp.
S. Khabir, Washington River Protection Solutions/Hanford
J. Levinson, Newport News Shipbuilding

J. S. MacMurray, Savannah River National Laboratory
G. G. Pyle, Knolls Atomic Power Laboratory
D. Scheopflin, Washington River Protection Solutions, LLC
R. R. Sommer II, NUCON International, Inc.
M. T. Sorna, Puget Sound Naval Shipyard
G. L. Laws, *Contributing Member*, Washington State Department of Health — Radiation Protection
D. P. Nguyen, *Contributing Member*, U.S. Army Edgewood Chemical Biological Center
G. D. Singleton, *Contributing Member*, AAF International

SUBCOMMITTEE ON VENTILATION AIR CONDITIONING EQUIPMENT

D. Ghosh, *Chair*, Southern Nuclear
M. J. Fox, *Vice Chair*, ECU Corp.
T. B. Axley, Jr., Consultant
B. C. Elliott, Super Radiator Coils
M. R. Hargan, Hargan Engineering
R. Kim, Finetec Century America, Inc.
T. J. Schafer, Sargent & Lundy, LLC

C. Wojcik, PMT Nuclear
W. P. Drosjack, *Contributing Member*, Consultant
R. N. Knoche, *Contributing Member*, Consultant
I. Kutuzov, Alfa Laval, Inc. (Canada)
T. A. Meisner, *Contributing Member*, Consultant
G. Roca, *Contributing Member*, Westinghouse Electric Spain

CORRESPONDENCE WITH THE COMMITTEE ON NUCLEAR AIR AND GAS TREATMENT

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

Secretary, Standards Committee on Nuclear Air and Gas Treatment
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 Code to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Code. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Code. 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 Code 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 Code to which the proposed Case applies.

Interpretations. Upon request, the Standards Committee on Nuclear Air and Gas Treatment (CONAGT) will render an interpretation of any requirement of the Code. Interpretations can only be rendered in response to a written request sent to the Secretary of CONAGT.

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 CONAGT 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 Code 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 Code 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. CONAGT 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 CONAGT.

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: Heat Exchangers

Section GB: Noble Gas Hold-Up Equipment

Section GC: Gas Compressors and Exhausters

Section GD: Other Radionuclide Equipment

Section GE: Hydrogen Recombiners and Igniters

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: Noble Gas Hold-Up 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 lowercase letters in parentheses to major subparagraph numbers, such as BA-1111.1(a)