

ASME CSD-1–2018
(Revision of ASME CSD-1–2015)

Controls and Safety Devices for Automatically Fired Boilers

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

ASME CSD-1-2018
(Revision of ASME CSD-1-2015)

Controls and Safety Devices for Automatically Fired Boilers

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: October 12, 2018

The next edition of this Standard is scheduled for publication in 2021.

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

Errata to codes and standards may be posted on the ASME website 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 based 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 agreed to 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" an 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, are 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		v
Committee Roster		vi
Correspondence With the CSDAFB Committee		vii
Summary of Changes		ix
Part CG	General	1
CG-100	General Requirements	1
CG-200	General Provisions	2
CG-300	Material Requirements	2
CG-400	Testing and Maintenance	2
CG-500	Certification and Reporting	3
CG-600	Operation	3
CG-700	Definitions	3
Part CM	Testing and Maintenance	9
CM-100	Periodic Testing and Maintenance	9
Part CE	Electrical	10
CE-100	Electrical Requirements	10
Part CW	Steam and Waterside Control	12
CW-100	Automatic Low-Water Fuel Cutoff and/or Combined Water Feeding Device	12
CW-200	Automatic Fuel Cutoff for Forced Circulation Boilers	14
CW-300	Pressure Controls	14
CW-400	Temperature Controls	15
CW-500	Safety and Safety Relief Valves	15
CW-600	Modular Boilers	16
CW-700	Vacuum Boiler	16
Part CF	Combustion Side Control	17
CF-100	Gas-Fired Boiler Units, Equipment	17
CF-200	Gas-Fired Boiler Units, Purging	26
CF-300	Gas-Fired boiler Units, Safety Controls	27
CF-400	Oil-Fired Boiler Units, Equipment	28
CF-500	Oil-Fired Boiler Units, Safety Controls	30
CF-600	Low Fire Start, Gas- or Oil-Fired Boiler Units	31
CF-700	Combination Gas- and Oil-Fired Units	31
CF-800	Electrically Heated Boilers	31
CF-900	Combustion Side Controls for Modular Boilers	31
Nonmandatory Appendices		
A	Comparison of This Standard and ANSI Z21.13/CSA 4.9	32
B	Typical Fuel Trains	33

C	Manufacturer's/Installing Contractor's Report for ASME CSD-1	44
D	Recommended Preventive Maintenance Schedule	47
E	References	52
F	Guidance for the Use of U.S. Customary and SI Units in ASME CSD-1	53

Figures

CG-1	Sediment Trap	8
B-1	Typical Gas Fuel Train With Pilot Ignition System and Atmospheric Burners [Greater Than 400,000 Btu/hr (117 kW) and Less Than or Equal to 2,500,000 Btu/hr (733 kW)]	34
B-2	Typical Gas Fuel Train With Pilot Ignition System [Greater Than 400,000 Btu/hr (117 kW) and Less Than or Equal to 2,500,000 Btu/hr (733 kW)]	35
B-3	Typical Gas Fuel Train With Direct Ignition System [Greater Than 400,000 Btu/hr (117 kW) and Less Than or Equal to 2,500,000 Btu/hr (733 kW)]	37
B-4	Typical Gas Fuel Train With Pilot Ignition System [Greater Than 2,500,000 Btu/hr (733 kW) and Less Than or Equal to 5,000,000 Btu/hr (1 465 kW)]	38
B-5	Typical Gas Fuel Train With Pilot Ignition System [Greater Than 5,000,000 Btu/hr (1 465 kW) and Less Than 12,500,000 Btu/hr (3 663 kW)]	40
B-6	Typical Gas Fuel Train With Pilot Ignition System and Negative (Zero Governor) Main Manifold Gas Pressure [Greater Than 400,000 Btu/hr (117 kW) and Less Than 12,500,000 Btu/hr (3 663 kW)]	41
B-7	Typical Gas Fuel Train With Direct Ignition System and Negative (Zero Governor) Main Manifold Gas Pressure [Greater Than 400,000 Btu/hr (117 kW) and Less Than 12,500,000 Btu/hr (3 663 kW)]	42
B-8	Typical Oil Fuel Train	42
B-9	Example for Sizing of Manifolder Lines	43
B-10	Typical Gas Fuel Train Safety Shutoff Valve Arrangements for Multiple-Burner Boiler Units Complying With CF-180(b)	43

Tables

CF-1	400,000 Btu/hr (117 kW) and Smaller (Gas — Natural Draft)	18
CF-2	400,000 Btu/hr (117 kW) and Smaller (Power Gas Burners, Mechanical Draft Atmospheric Gas Burners, and Pulse Combustion Systems), 3 gph (11.4 L/h) [Approximately 400,000 Btu/hr (117 kW)] and Smaller (Oil)	19
CF-3	Safety Controls for Automatically Fired Units: Power Gas Burners, Mechanical Draft Atmospheric Gas Burners, and Pulse Combustion Systems	21
CF-4	Safety Controls for Automatically Fired Units: Atmospheric Gas Burners — Natural Draft	23
CF-5	Safety Controls for Automatically Fired Units: Oil-Fired Burners	29
B-1	Figure Index	33
D-1	Periodic Testing Recommended Checklist	49

FOREWORD

The major perils in operating automatically fired boilers are loss of water (low water), furnace explosion, overpressure and overtemperature. Principal causes of accidents to automatically fired boilers are lack of proper controls and safety devices, lack of adequate maintenance, improperly trained operators, failure to test controls and safety devices, and complacency on the part of the operator due to long periods of trouble-free operation. It is believed that improved instrumentation, controls and safety devices, proper operating procedures, and a clearer understanding of installation requirements by the manufacturers, installers, and operators can greatly reduce the chances of personal injury, damage to property, and loss of equipment from accidents.

It should be pointed out that any governmental jurisdiction has authority over any particular installation. Inquiries dealing with problems of a local character should be directed to the proper authorities of such jurisdictions.

Safety codes and standards are intended to enhance public health and safety. Revisions result from the committee's consideration of factors such as technological advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

The first edition of this Standard, which was approved by The American Society of Mechanical Engineers' Committee on Controls and Safety Devices for Automatically Fired Boilers, was approved and designated as an ASME Standard by The American Society of Mechanical Engineers on April 29, 1977.

The second edition, which was approved by the American National Standards Institute (ANSI) on October 4, 1982, was issued on December 31, 1982. An addenda to the edition, CSD-1a-1984, was approved on August 17, 1984 and issued on November 15, 1984.

The third edition, which was approved by ANSI on November 17, 1983, was issued on February 15, 1989. The CSD-1a-1989 Addenda was approved on October 3, 1989 and issued on February 15, 1990. The CSD-1b-1990 Addenda was approved on June 21, 1990 and issued on December 1, 1990.

The fourth edition, which was approved by ANSI on February 28, 1992, was issued on June 15, 1992. The CSD-1a-1993 Addenda was approved on August 18, 1993 and issued on November 30, 1993. The CSD-1b-1994 Addenda was approved on June 20, 1994 and issued on September 30, 1994.

The fifth edition, which was approved by ANSI on February 6, 1995, was issued on June 30, 1995. The CSD-1a-1996 Addenda was approved on February 5, 1996 and issued on July 31, 1996. The CSD-1b-1996 Addenda was approved on July 16, 1996 and issued on December 20, 1996.

The sixth edition, which was approved by ANSI on January 30, 1998, was issued on April 14, 1998. The CSD-1a-1999 Addenda was approved on November 2, 1999 and issued on March 10, 2000. The CSD-1b-2001 Addenda was approved on July 30, 2001 and issued on November 10, 2001.

The seventh edition, which was approved by ANSI on January 17, 2002, was issued on April 15, 2002.

The eighth edition, which was approved by ANSI on August 9, 2004, was issued on April 15, 2005.

The ninth edition, which was approved by ANSI on September 13, 2006, was issued on December 29, 2006.

The tenth edition, which was approved by ANSI on February 24, 2009, was issued on May 8, 2009.

The eleventh edition, which was approved by ANSI on January 13, 2012, was issued on May 10, 2012.

The twelfth edition of CSD-1, which was approved by ANSI on December 21, 2015, was issued on March 24, 2016.

This thirteenth edition of CSD-1, which was approved by ANSI on August 23, 2018, was issued on October 12, 2018.

ASME CSDAFB COMMITTEE

Controls and Safety Devices for Automatically Fired Boilers

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

STANDARDS COMMITTEE OFFICERS

J. Safarz, *Chair*
K. Carlisle, *Vice Chair*
C. R. Ramcharran, *Secretary*

STANDARDS COMMITTEE PERSONNEL

R. D. Austin , State of Arizona, Department of Safety and Health, Boiler Safety	J. Safarz , Selas Heat Technology, Co., LLC
E. J. Belski , Onecis Insurance Co.	D. Schirmer , Boiler and Property Consulting, LLC
J. Berezowski , Xylem, Inc.	A. Shahabi , Riello Canada
N. D. Butt , Weil-McLain	A. D. Silver , SCC, Inc.
K. Carlisle , Karl Dungs, Inc.	F. R. Switzer, Jr. , Safe, Inc.
J. P. Chicoine , Mestek, Inc.	M. Wadkinson , Fulton Thermal Corp.
T. D. Curtis , Industrial Combustion	J. Boyd , <i>Alternate</i> , Karl Dungs, Inc.
M. T. Fecke , Exponent Failure Analysis Associates	T. M. Griffin , <i>Alternate</i> , The Hartford Steam Boiler Insurance and Inspection
J. P. Fidgeon , Utility Plant Solutions	S. J. Guzik , <i>Alternate</i> , Naval Facilities Engineering Service Center
R. S. Glass , Raypak, Inc.	B. E. Lester , <i>Alternate</i> , SCC, Inc.
G. M. Halley , American Boiler Manufacturers Association	J. Marten , <i>Alternate</i> , Exponent, Inc.
T. F. Hardin , UL, Inc.	K. F. Nelson , <i>Alternate</i> , UL, LLC
T. Q. Huynh , Miura Canada Co., Ltd.	J. O'Callahan , <i>Alternate</i> , Xylem, Inc.
J. L. Kleiss , Lochinvar, LLC	J. Pettirord , <i>Alternate</i> , The Fulton Co.
R. Labore , Fireye, Inc.	P. H. Schuelke , <i>Alternate</i> , Weil-McLain
J. R. Lamore , Honeywell Thermal Solutions	T. Shernisky , <i>Alternate</i> , Onecis Insurance Co.
J. C. Merwin , Potter Electric Signal Co.	J. C. Stoeger , <i>Alternate</i> , Industrial Combustion
B. L. Mickelson , Honeywell International, Inc.	G. A. Tompkins , <i>Alternate</i>
B. W. Moore , Hartford Steam Boiler	D. C. Wiggins , <i>Alternate</i> , Lochinvar, LLC
C. E. Murray , U.S. Navy	R. K. Black , <i>Honorary Member</i> , Johnston Boiler Co.
S. V. Nelson , State of Colorado	T. W. Bukowski , <i>Honorary Member</i> , Weber-Stephen Products Co.
V. G. Newton , Boiler & Property Consulting, LLC	R. B. West , <i>Honorary Member</i> , State of Iowa, Division of Labor Services
C. R. Ramcharran , The American Society of Mechanical Engineers	

CORRESPONDENCE WITH THE CSDAFB COMMITTEE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ASME CSD-1-2018 SUMMARY OF CHANGES

Following approval by the ASME CSDAFB Committee and ASME, and after public review, ASME CSD-1-2018 was approved by the American National Standards Institute on August 23, 2018.

ASME CSD-1-2018 includes the following changes identified by a margin note, **(18)**.

<i>Page</i>	<i>Location</i>	<i>Change</i>
2	CG-230	Revised
3	CG-700	(1) Term <i>gas-pressure regulator, main</i> added (2) Definitions for <i>branch burner; main; multi-burner boiler unit; pressure regulator, gas, main; pressure regulator, zero governor; shall; and should</i> added
11	CE-170	Added
12	CW-110	Subparagraphs (c) and (d) revised
12	CW-120	Title and subparagraph (a) revised
14	CW-210	Revised
15	CW-410	Subparagraphs (a), (b), and (c) revised
19	Table CF-2	Title revised
20	CF-162	Revised in its entirety
21	Table CF-3	Tenth entry in third column revised
24	CF-180	Revised in its entirety
28	CF-330	Subparagraphs (a), (b), and (c) revised
30	CF-470	Revised
29	Table CF-5	First entry of second column and Note (1) revised
30	CF-480	Revised
31	CF-530	Revised
33	Nonmandatory Appendix B	Revised in its entirety
47	Nonmandatory Appendix D	Revised

Part CG

General

CG-100 GENERAL REQUIREMENTS

CG-110 Scope

The rules of this Standard cover requirements for the assembly, installation, maintenance, and operation of controls and safety devices on automatically operated boilers directly fired with gas, oil, gas-oil, or electricity, subject to the service limitations, exclusions, and acceptance of other listings in [CG-120](#), [CG-130](#), and [CG-140](#), respectively. Burner or burner assemblies installed on boilers or as a replacement burner shall comply with the requirements of [CF-110](#) and [CF-410](#) for gas and oil firing, respectively. The use of a gaseous or oil fuel not listed in the definitions has not been evaluated, and special considerations may be required.

CG-120 Service Limitations

The rules of this Standard are applicable to the following service:

(a) all automatically fired boilers and burner assemblies, regardless of fuel input ratings subject to the exclusions and acceptance to other listings of [CG-130](#) and [CG-140](#), respectively

(b) burners field-installed in automatically fired boilers

CG-130 Exclusions

The following are excluded from the requirements of this Standard:

(a) boilers with fuel input ratings greater than or equal to 12,500,000 Btu/hr (3 663 kW), falling within the scope of NFPA 85, Boiler and Combustion Systems Hazard Code

(b) water heaters (see [CG-700](#))

(c) direct gas-fired swimming pool heaters that are labeled and listed by a nationally recognized testing agency or other organization that is acceptable to the authority having jurisdiction as complying with ANSI Z21.56/CSA 4.7, Standard for Gas-Fired Pool Heaters

CG-140 Acceptance of Other Listings

The following other listings are acceptable:

(a) automatically operated boilers fired with gas having inputs of 400,000 Btu/hr (117 kW) or less that

(1) comply with [Part CW](#), [CE-110\(a\)](#), [CE-110\(b\)](#), and [CE-110\(j\)](#)

(2) are labeled and listed by a nationally recognized testing agency or other organization that is acceptable to the authority having jurisdiction as complying with ANSI Z21.13/CSA 4.9, Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers; meet the remaining requirements of this Standard (see [Nonmandatory Appendix A](#))

(b) automatically operated boilers fired with oil having inputs of 3 gph (11.4 L/h) or less that

(1) comply with [Part CW](#), [CE-110\(a\)](#), [CE-110\(b\)](#), and [CE-110\(j\)](#)

(2) are labeled and listed by a nationally recognized testing agency or other organization that is acceptable to the authority having jurisdiction as complying with UL 726, Standard for Oil-Fired Boiler Assemblies; meet the remaining requirements of this Standard

(c) automatically operated, electrically heated boilers having inputs of 115 kW or less that

(1) comply with [Part CW](#), [CE-110\(a\)](#), and [CE-110\(b\)](#)

(2) are labeled and listed by a nationally recognized testing agency or other organization that is acceptable to the authority having jurisdiction as complying with UL 834, Standard for Heating, Water Supply, and Power Boilers — Electric; meet the remaining requirements of this Standard

CG-150 Jurisdictional Adoption of ASME CSD-1

Adoption of ASME CSD-1 by a jurisdiction shall not preclude the jurisdiction adopting and accepting boilers listed or certified to other safety standards or codes acceptable to the jurisdiction beyond the limitations contained in [CG-140](#). Where other such safety codes and/or standards are adopted/accepted and overlap with the scope of ASME CSD-1, it shall be the responsibility of the jurisdiction to define the application of this Standard and those other codes and/or standards.

CG-160 Metric (SI) Units

This edition of the Standard uses U.S. Customary units. The acceptable equivalent SI units are shown in parentheses for information only and have been directly (soft) converted from the U.S. Customary units.