NFPA 8502

Standard for the Prevention of Furnace Explosions/ Implosions in Multiple Burner Boilers

1999 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

IMPORTANT NOTICE ABOUT THIS DOCUMENT

NFPA codes and standards, of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this document available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the NFPA list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

NOTICES

All questions or other communications relating to this document and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

Users of this document should be aware that this document may be amended from time to time through the issuance of Tentative Interim Amendments, and that an official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments then in effect. In order to determine whether this document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments, consult appropriate NFPA publications such as the *National Fire Codes*® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed above.

A statement, written or oral, that is not processed in accordance with Section 16 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

The NFPA does not take any position with respect to the validity of any patent rights asserted in connection with any items which are mentioned in or are the subject of this document, and the NFPA disclaims liability of the infringement of any patent resulting from the use of or reliance on this document. Users of this document 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.

Users of this document should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action that is not in compliance with applicable laws, and this document may not be construed as doing so.

NFPA 8502

Standard for the Prevention of

Furnace Explosions/Implosions in Multiple Burner Boilers

1999 Edition

This edition of NFPA 8502, *Standard for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boilers*, was prepared by the Technical Committee on Multiple Burner Boilers, released by the Technical Correlating Committee on Boiler Combustion System Hazards, and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 16–18, 1998, in Atlanta, GA. It was issued by the Standards Council on January 15, 1999, with an effective date of February 4, 1999, and supersedes all previous editions.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

This edition of NFPA 8502 was approved as an American National Standard on February 4, 1999.

Origin and Development of NFPA 8502

This document originated as a compilation of the following four standards:

NFPA 85B, *Standard for the Prevention of Furnace Explosions in Natural Gas-Fired Multiple Burner Boiler-Furnaces*

NFPA 85D, *Standard for the Prevention of Furnace Explosions in Fuel Oil-Fired Multiple Burner Boiler-Furnaces*

NFPA 85E, *Standard for the Prevention of Furnace Explosions in Pulverized Coal-Fired Multiple Burner Boiler-Furnaces*

NFPA 85G, *Standard for the Prevention of Furnace Implosions in Multiple Burner Boiler-Furnaces*

In 1964, NFPA 85B was prepared by what was then the Sectional Committee on Public Utility Units and was tentatively adopted. In the following year and a half, the tentative standard was subjected to intensive study by the electric utility industry, boiler manufacturers, insurers, consultants, and others. The first official edition of NFPA 85B, adopted in 1966, incorporated the revisions that resulted from this study.

During this same period, NFPA 85D was prepared and was tentatively adopted in 1966. Revisions were adopted in 1967, but the status of the standard remained tentative.

NFPA 85E was prepared and eventually adopted as a tentative standard in May 1968. Amendments were adopted in 1969 to strengthen the standard and to provide more uniformity among NFPA 85B, NFPA 85D, and NFPA 85E, but its status remained tentative. Amendments also were made to NFPA 85B and NFPA 85D in 1969, and NFPA 85D was officially adopted that year.

NFPA 85B and NFPA 85D were revised again in 1970. NFPA 85B, NFPA 85D, and NFPA 85E were amended in 1971, and NFPA 85E was officially adopted. In 1972, provisions were added to NFPA 85D to cover crude oil firing, and amendments were made to all three documents in 1973 and 1974. A new section covering boilers with a small number of burners and a new Appendix B were added to NFPA 85B and NFPA 85D in 1976.

The increased size of furnaces in utility boilers, along with changes in technology, introduced the problem of excessive negative pressure excursion development within the furnace setting. In 1976, a task group was appointed to investigate this problem. As a result of the task group investigation, it was concluded that a new standard for the prevention of furnace implosions was needed, and the development of NFPA 85G was initiated. NFPA 85G was published first in 1978. The official adoption of NFPA 85G in 1978 was accompanied by amendments to NFPA 85B, NFPA 85D, and NFPA 85E.

NFPA 85E and NFPA 85G were revised in 1980, followed by amendments to NFPA 85G in 1982. NFPA 85B and NFPA 85D were both revised in 1984. The most current of these four standards were the 1989 editions of NFPA 85B and NFPA 85D, the 1985 edition of NFPA 85E, and the 1987 edition of NFPA 85G.

In late 1988, the subcommittee responsible for these four documents was assigned the task of combining them into a single document for consistency and ease of management. The 1991 edition of NFPA 85C was the result of this effort.

In 1993, the technical committee responsible for NFPA 85C was assigned the task of revising this document and for redesignating it as NFPA 8502, *Standard for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boilers*. The purpose of this redesignation was consistency with other NFPA 8500 series documents on boilers, furnaces, and related equipment. The 1995 edition of NFPA 8502 was the result of this effort.

This 1999 edition incorporates several changes to the standard. The most notable change allows simultaneous firing of multiple fuel types. Other changes added new definitions and streamlined the document.

Technical Correlating Committee on Boiler Combustion System Hazards

Dale E. Dressel, *Chair*
Solutia Inc., MO [U]

Merton W. Bunker, *Nonvoting Secretary*
Nat'l Fire Protection Assn., MA

Terry Michael Bartels, Kansas City Power & Light Co., MO [U]
Rep. Edison Electric Inst.
Johnny W. (Bill) Bass, Forney Corp., TX [M]
James R. Bostick, Bailey Controls Co., OH [M]
Thaddeus Bukowski, Underwriters Laboratories Inc., IL [RT]
William E. Cunningham, Jr., Raytheon Engr & Constructors, MA [SE]
John C. deRuyter, The DuPont Co., DE [U]
Robert S. Elek, Kemper Nat'l Insurance Cos., OH [I]
Ronald E. Fringeli, J&H Marsh & McLennan, OH [I]
Steven K. Funk, The DuPont Co., TX [U]
Rep. American Petroleum Inst.
Gordon G. Gaetke, Union Carbide Corp., WV [U]
Masaaki Kinoshita, Mitsubishi Heavy Industries Ltd, Japan [M]
Donald J. L. Lin, Qilin Inc., TX [SE]
Robert Malanga, Union Camp Corp, NJ [U]
Francis X. Maskol, Honeywell, Inc., GA [M]
Russell N. Mosher, American Boiler Mfrs. Assn., VA [M]
Jerry J. Moskal, ABB Combustion Engr Inc., CT [M]
Michael C. Polagye, Factory Mutual Research Corp., MA [I]
Nancy C. Polosky, Babcock & Wilcox, OH [M]
James L. Sherman, Baltimore Gas & Electric Co., MD [U]
Peter J. Gore Willse, HSB Industrial Risk Insurers, CT [I]
Henry K. Wong, Foster Wheeler Energy Corp., NJ [M]

Alternates

Tetsuya Fujino, Mitsubishi Heavy Industries America, Inc., CA [M]
(Alt. to M. Kinoshita)
Raymond J. Heitland, Solutia Inc., FL [U]
(Alt. to D. E. Dressel)
Dennis P. Jenkins, Kemper Nat'l Insurance Cos., NC [I]
(Alt. to R. S. Elek)
Gerald E. McCullion, Honeywell, Inc., GA [M]
(Alt. to F. X. Maskol)
John P. O'Rourke, ABB Combustion Engr Inc., CT [M]
(Alt. to J. J. Moskal)
Richard J. Wachter, HSB Industrial Risk Insurers, CT [I]
(Alt. to P. J. G. Willse)
Harold R. Yates, Detroit Edison, MI [U]
(Voting Alt. to Detroit Edison Rep.)
William G. Yeich, Exxon Research and Engr Co., NJ [U]
(Alt. to S. K. Funk)

Nonvoting

Courtney D. Alvey, Baltimore, MD [SE]
William H. Axtman, Gray Gull Assoc., Inc., VA
Shelton Ehrlich, Palo Alto, CA
Thomas B. Hamilton, Hamilton Consulting Services, NC
Robert P. Kaltenbach, Burns & McDonnell Eng, MO [SE]
Peter B. Matthews, Hartford Steam Boiler Insp & Ins Co., CT

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of this document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the reduction of combustion system hazards in single- and multiple burner boilers with a heat input rate of 12,500,000 Btu/hr and above. This includes all fuels. This Committee also is responsible for documents on the reduction of hazards in pulverized fuel systems, fluidized-bed boilers, heat recovery steam generators, and stoker-fired boilers, at any heat input rate.

Technical Committee on Multiple Burner Boilers

Robert P. Kaltenbach, *Chair*
Burns & McDonnell Engr, Co., MO [SE]

Francis X. Maskol, *Secretary*
Honeywell, Inc., GA [M]

Samuel H. Allen, Dow Chemical U.S.A., LA [U]
Courtney D. Alvey, Baltimore, MD [SE]
Johnny W. (Bill) Bass, Forney Corp., TX [SE]
Thomas A. Collette, Commonwealth Edison, IL [U]
Dale E. Dressel, Solutia Inc., MO [U]
John J. Eibl, The DuPont Co., TN [U]
Kenneth Joe Frazier, Salt River Project, AZ [U]
H. C. Gery, Doylestown, PA [SE]
Bernard Hrul, Allen Bradley Co., OH [U]
George Y. Keller, Burns & Roe Enterprises, Inc., NJ [SE]
Blair E. Kerstetter, The Foxboro Co., MA [M]
Daniel J. Lee, Bailey Controls Co., OH [M]
W. Scott Matz, Triconex Corp., TX [SE]
Pete McKenna, Stone & Webster, MA [SE]
Lalit M. Mehta, Coen Co., Inc., CA [M]
Edward G. Milone, Consolidated Edison of New York, NY [U]
Russell N. Mosher, American Boiler Mfrs. Assn., VA [M]
John P. O'Rourke, ABB Combustion Engr Inc., CT [M]
Francisco A. Palacios, DB Riley, Inc., MA [M]
Michael C. Polagye, Factory Mutual Research Corp., MA [I]
Joseph M. Vavrek, Sargent & Lundy, IL [SE]
Peter J. Gore Willse, HSB Industrial Risk Insurers, CT [I]
James M. Witt, Jr., Southern Company, GA [U]
Henry K. Wong, Foster Wheeler Energy Corp., NJ [M]
Harold R. Yates, Detroit Edison, MI [U]
Allan J. Zadiraka, Babcock & Wilcox, OH [M]

Alternates

John E. Bollinger, Babcock & Wilcox, OH [M]
(Alt. to A. J. Zadiraka)
John C. deRuyter, The DuPont Co., DE [U]
(Alt. to J. J. Eibl)
Raymond J. Heitland, Solutia Inc., FL [U]
(Alt. to D. E. Dressel)
Jerry J. Moskal, ABB Combustion Engr Inc., CT [M]
(Alt. to J. P. O'Rourke)
Charles A. Sewell, Dow Chemical U.S.A., TX [U]
(Alt. to S. H. Allen)
Bill L. Smith, Jr., Burns & McDonnell Engr Co., MO [SE]
(Alt. to R. P. Kaltenbach)

Nonvoting

Thomas C. Clayton, Black & Veatch, MO
Robert M. Lundberg, Los Altos, CA
(Member Emeritus)

Merton W. Bunker, Jr., NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of this document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents covering the reduction of combustion system hazards and the prevention of boiler furnace explosions and implosions in multiple burner boilers with a heat input rate of 12,500,000 Btu/hr and above. This includes all fuels.

Contents

NFPA 8502

Standard for the Prevention of

Furnace Explosions/Implosions in Multiple Burner Boilers

1999 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 10 and Appendix B.

FOREWORD

Technological advances in recent years and, in particular, the pervasiveness of microprocessor-based hardware make it even more important that only highly qualified individuals be employed in applying the requirements of this standard to operating systems. Each type of hardware has its own unique features and operational modes. It is vital that the designer of the safety system be completely familiar with the features and weaknesses of the specific hardware and possess a thorough understanding of this standard and its intent.

It is not possible for this standard to encompass all specific hardware applications, nor should this standard be considered a "cookbook" for the design of a safety system.

Where applying any type of equipment to a safety system, the designer should consider carefully all of the possible failure modes and the effect that each might have on the integrity of the system and the safety of the unit and personnel. In particular, no single point failure should result in an unsafe or uncontrollable condition or a masked failure of a microprocessor-based system that could result in the operator unwittingly taking action that could lead to an unsafe condition.

This document is to be used for the design, installation, operation, and maintenance of multiple burner boilers and their burner management and combustion control systems. The standard is organized as follows:

(a) The introduction and those sections that apply to all fuels covered in this standard (Chapters 1–5 and Chapter 9).

(b) Detailed sections that specifically apply to the particular fuel fired. Chapter 6 applies to fuel gas systems. Chapter 7 applies to fuel oil systems. Chapter 8 applies to pulverized coal systems.

When using this standard, the sections that apply to all fuels covered should be used in conjunction with those covering the specific fuel utilized. The appendixes include additional useful information but are not mandatory.

Chapter 1 Introduction

1-1 Scope.

1-1.1 This standard shall apply to boilers with a fuel input rating of 12,500,000 Btu/hr (3663 kW) or greater. This standard shall apply to multiple burner boilers firing one or more of the following:

(a) Fuel gas, as defined in Chapter 3

(b) Fuel oil, as defined in Chapter 3

(c) Pulverized coal, as defined in Chapter 3

1-1.2 This standard includes simultaneous firing of more than one fuel.

1-1.3* This standard is not retroactive. This standard shall apply to new installations and to major alterations or extensions that are contracted subsequent to the effective date of this standard.

1-1.4 Furnaces such as those of process heaters used in chemical and petroleum manufacture, wherein steam generation is incidental to the operation of a processing system, are not covered by this standard.

1-1.5 Since this standard is based on the current state of the art, its application to existing installations is not mandatory. Nevertheless, operating companies are encouraged to adopt those features of this standard that are applicable for existing installations.

1-1.6 Chapter 5 prescribes methods for minimizing the risk of negative furnace draft in excess of furnace structural capability.

1-1.7 Chapter 6 includes requirements for burner management, combustion control systems, and operating procedures for boilers utilizing fuel gas as defined in Chapter 3.

1-1.8 Chapter 7 includes requirements for burner management, combustion control systems, and operating procedures for boilers utilizing fuel oils as defined in Chapter 3.

1-1.9 Chapter 8 includes requirements for burner management, combustion control systems, and operating procedures for boilers utilizing pulverized coal as defined in Chapter 3.

1-1.10 The appendixes contain information viable to the design and understanding of this standard. Therefore the user of this standard shall be familiar with the contents of the appendixes.

1-2 Purpose.

1-2.1 The purpose of this document is to contribute to operating safety and to prevent furnace explosions and implosions. It establishes minimum standards for the design, installation, operation, and maintenance of boilers and their fuel-burning, air supply, and combustion products removal systems. The standard requires the coordination of operating procedures, control systems, interlocks, and structural design.

1-2.2* No standard guarantees the elimination of furnace explosions and implosions in boilers. Technology in this area is evolving constantly, as reflected in revisions to this standard. The user of this standard needs to recognize the complexity of firing fuel with regard to the type of equipment and the characteristics of the fuel. Therefore, the designer is cautioned that the standard is not a design handbook. The standard does not eliminate the need for the engineer or for competent engineering judgment. It is intended that a designer capable of applying more complete and rigorous analysis to special or unusual problems is to be given latitude in the development of such designs. In such cases, the designer is responsible for demonstrating the validity of the proposed design.

1-2.3 Emphasis is placed on the importance of structure strength, operation and maintenance procedures, combustion and draft control equipment, safety interlocks, alarms, trips, and other related controls that are essential to boiler operation.

1-2.4 Gas cleanup systems located downstream of the post-combustion gas passes of the boiler furnace shall be coordi-