

NFPA 8505

Standard for Stoker Operation

1998 Edition



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

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NFPA 8505
Standard for
Stoker Operation
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This edition of NFPA 8505, *Standard for Stoker Operation*, was prepared by the Technical Committee on Stoker Operations, 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 17–19, 1997, in Kansas City, MO. It was issued by the Standards Council on January 16, 1998, with an effective date of February 6, 1998, and supersedes all previous editions.

This edition of NFPA 8505 was approved as an American National Standard on February 6, 1998.

Origin and Development of NFPA 8505

In 1984 the Technical Committee on Boiler-Furnace Explosions started working on a document for stoker operations. The first edition of NFPA 85I was issued in 1989. This was developed through numerous task force, subcommittee, and Technical Committee meetings. The document was written to provide user requirements in order to limit the hazards associated with these special systems and to broaden the NFPA 85 series of standards, which dealt with safe boiler operation.

The 1989 edition was a partial revision and included a variety of changes. Foremost was the renumbering of the document to NFPA 8505.

The 1998 edition is a complete revision of the document. The document has been revised to change the language to mandatory text and to rename the document as a standard. Additional changes have been made to correlate this standard with the other five NFPA 8500 series standards.

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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.

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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 operation of stokers and related fuel-burning equipment. This includes all fuels at any heat input rate.

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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 8 and Appendix D.

Chapter 1 Introduction

1-1 Scope.

1-1.1 This standard shall apply to boilers with a heat input rating of 12,500,000 Btu/hr (3663 kW) or greater. This standard shall apply only to boilers using a stoker to fire the following fuels:

- (a) Coal, as defined in Chapter 3
- (b) Wood
- (c) Refuse-derived fuel (RDF), as defined in Chapter 3
- (d) Municipal solid waste (MSW) as defined in Chapter 3
- (e) Other solid fuels

When solid fuel is fired simultaneously with other fuels (e.g., solid fuel stoker fired in combination with gas, oil, or pulverized auxiliary fuel), additional controls and interlocks might be necessary; however, these are not covered in this standard. When firing gas, oil, or pulverized fuel alone, the NFPA standard that applies to that fuel shall be used.

1-1.2 Requirements for auxiliary fuel-firing equipment and interlocks shall comply with NFPA 8501, *Standard for Single Burner Boiler Operation*, or NFPA 8502, *Standard for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boilers*.

Exception No. 1: The purge requirements of NFPA 8501 or NFPA 8502 shall not be required when the stoker is firing and the boiler is on-line. In those cases, if no cooling air is being provided to the auxiliary burners, a purge of their associated air supply ducts shall be provided.

Exception No. 2: When firing oil or gas in a supervised manual system in accordance with NFPA 8501, the excessive steam pressure interlock shall not be required.

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 Since this standard is based on the present 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 considered applicable and reasonable for existing installations.

1-1.5 Revisions to this document reflect the current state of knowledge and do not imply that previous editions were inadequate.

1-2 Purpose.

1-2.1 The purpose of this standard shall be to establish minimum standards for the design, installation, operation, and maintenance of stoker-fired boilers, their fuel-burning systems, and related control equipment, to contribute to operating safety.

1-2.2 No standard can guarantee 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 this standard is not a design handbook. This standard shall 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 shall be responsible for demonstrating the validity of the proposed design.

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

1-2.4 The effect of gas cleanup systems located downstream of the post-combustion gas passes of the boiler furnace is known to be significant. Coordination of the operating procedures and design of the boiler furnace system and air quality system air-flue gas path shall be required. Such coordination shall include requirements for ensuring a continuous flow path from the forced draft fan inlet through the stack. This standard provides only the general requirements for these systems because of the multiplicity of their designs.

Chapter 2 General

2-1 Furnace Explosions.

2-1.1 The basic cause of furnace explosions is the ignition of an accumulated combustible mixture within the confined space of the furnace or the associated boiler passes, ducts, and fans that convey the gases of combustion to the stack.

2-1.2 A dangerous combustible mixture within the boiler enclosure consists of the accumulation of an excessive quantity of combustibles mixed with air in proportions that result in rapid or uncontrolled combustion where an ignition source is supplied. A furnace explosion can result from ignition of this accumulation if the quantity of combustible mixture and the proportion of air to fuel are such that an explosive force is created within the boiler enclosure. The magnitude and intensity of the explosion depends on both the relative quantity of combustibles that have accumulated and the proportion of air that mixes with the combustibles at the moment of ignition. Explosions, including "furnace puffs," are the result of improper operating procedures by personnel; improper design of equipment or control systems; or malfunction of the equipment or control system, consistency of fuel, or moisture content of fuel.

2-1.3 Numerous conditions can arise in connection with the operation of a boiler that produce explosive conditions. The most common of these are as follows:

- (a) An interruption of the fuel or air supply sufficient to result in momentary loss of flames, followed by restoration and delayed reignition of an accumulation
- (b) Fuel leakage into an idle furnace and the ignition of the accumulation by a spark or other source of ignition

- (c) Attempts to light off without appropriate purging when firing gaseous, liquid, or pulverized fuels without stoker firing
- (d) Utilization of highly volatile fuels, such as gasoline, for ignition purposes
- (e) The accumulation of an explosive mixture of fuel and air as a result of loss of flame or incomplete combustion
- (f) The accumulation of an explosive mixture of fuel and air as a result of a flameout and the ignition of the accumulation by a spark or other ignition source, such as attempting to light burner(s)
- (g) Purging with too high an airflow, which stirs up combustibles smoldering in hoppers
- (h) Improper fuel consistency, especially when firing highly volatile refuse fuels

2-1.4 The conditions favorable for a boiler explosion described in 2-1.3 are typical examples. An examination of numerous reports of boiler explosions in stoker-fired units utilizing solid fuels suggests that the occurrence of small explosions or furnace puffs has been far more frequent than is usually recognized. It is believed that improved instrumentation, safety interlocks and protective devices, proper operating sequences, and a clearer understanding of the problem by both designers and operators can greatly reduce the risks and actual incidents of furnace explosions.

2-1.5 In a boiler, upset conditions or control malfunction may lead to an air/fuel mixture that may result in an unsafe condition. There may exist, in certain parts of the boiler enclosures or other parts of the unit, dead pockets susceptible to the accumulation of combustibles. These accumulations may ignite with explosive force in the presence of an ignition source.

2-2 Furnace Implosions.

2-2.1 Stoker-fired boilers are inherently less prone to furnace implosions because of the absence of the sudden “flame collapse” phenomenon that exists on fluid bed or pulverized fuel-fired boilers.

2-2.2 A furnace implosion is the result of the occurrence of excessively low gas-side pressure, which causes equipment damage.

2-2.3 Two conditions that have caused furnace implosions include the following:

- (a) A misoperation of the equipment regulating the boiler gas flow, including air supply and flue gas removal, resulting in furnace exposure to excessive induced-draft fan head capability
- (b) The rapid decay of furnace gas temperatures and pressure resulting from either a rapid reduction in fuel input or a master fuel trip

2-2.4 A combination of the two conditions indicated in 2-2.3 has resulted in the most severe furnace implosion incidents.

2-3 Manufacture, Design, and Engineering.

2-3.1 The purchaser or the purchaser’s agent shall, in cooperation with the manufacturer, ensure that the unit is not deficient in apparatus required for proper operation, so far as is practical, with respect to pressure parts, fuel-burning equipment, safe lighting, and maintenance of stable conditions.

2-3.2 All fuel systems shall include provisions to prevent foreign substances from interfering with the fuel supply.

2-3.3* An evaluation shall be made to determine the optimum integration of manual and automatic safety features, taking into consideration the advantages and disadvantages of each trip function.

2-3.4 This standard necessitates a minimum degree of automation. The trend toward more complex plants or increased automation shall require additional provisions for the following:

- (a) Information regarding significant operating events that allow the operator to make a rapid evaluation of the operating situation; provision of continuous and usable displays of variables that allow the operator to avoid unsafe conditions
- (b) In-service maintenance and checking of system functions without impairment of the reliability of the overall control system
- (c) An environment conducive to proper decisions and actions

2-3.5 On the basis of reported incidents and field tests, the maximum negative furnace pressure is determined primarily by the maximum head characteristic of the induced draft fan. A major objective of the final design shall be to limit the maximum head capacity of draft equipment to that necessary for satisfactory operation. Special consideration shall be given to fan selection and arrangement of ductwork to limit the effect of negative head.

2-3.6 With scrubbers or other high-draft-loss equipment for removing flue gas contaminants, a booster fan might be necessary. A bypass or other appropriate means shall be provided to counteract the potentially excessive negative pressure conditions resulting from combining the suction heads of both the induced draft fan and booster fan.

2-4 Installation.

2-4.1 The boiler shall not be permitted to be operated before the installation and check of the required safeguards and instrumentation system.

2-4.2 The party responsible for the erection and installation of the equipment shall ensure that all apparatus are installed and connected properly.

2-4.3 The purchaser, the engineering consultant, the equipment manufacturer, and the operating company shall avoid boiler operation until such safeguards have been tested and operated properly as a system. In some instances, it might be necessary to install temporary interlocks and instrumentation to meet these requirements. Any such temporary system shall be reviewed by the purchaser, the engineering consultant, the equipment manufacturer, and the operating company, and agreement shall be reached on its suitability in advance of start-up.

2-4.4 The safety interlock system and protective devices shall be tested jointly by the organization responsible for the system design and by those who operate and maintain such a system and devices during the normal operating life of the plant. After installation, coordinated tests of all systems shall be accomplished before initial operation.

2-5 Coordination of Design, Construction, and Operation.

2-5.1 Statistics indicate that human error is a contributing factor in the majority of furnace explosions. It is important to consider whether the error was the result of the following factors: